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THE ARCHITECTURAL RECORD

1934

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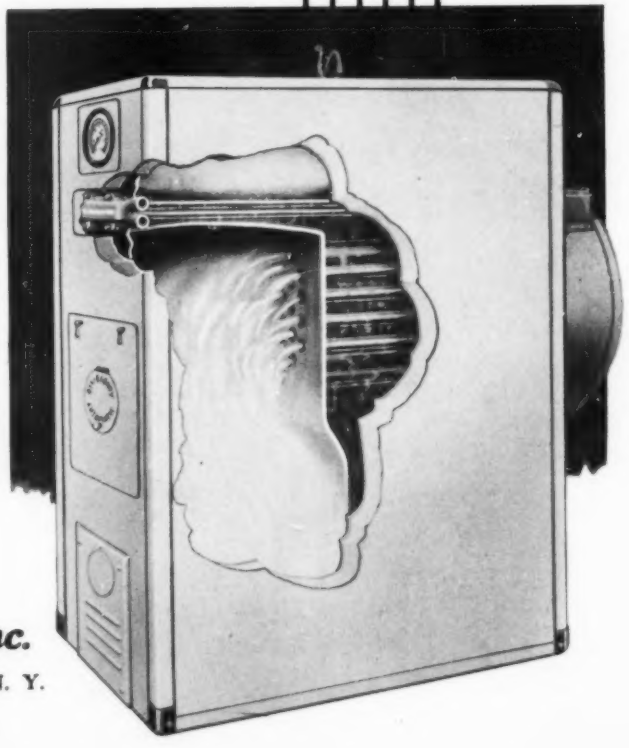

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James Gamble Rogers, Inc., Architects

THE ARCHITECTURAL RECORD

JANUARY, 1934
VOLUME 75
NUMBER 1

THE VINYLITE HOUSE . . . . . Frontispiece

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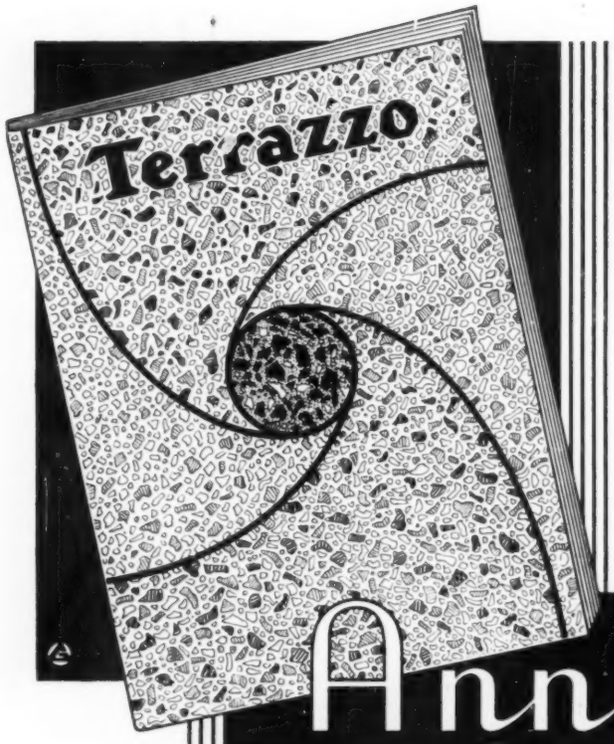

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To date there have been over fifty SPECIAL AGENTS appointed representing all sections of the country. Applications are still being received and further appointments will be made.

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LISTS OF SPECIAL AGENTS ARE AVAILABLE.

More detailed description of the plan outlined above will be sent on request.

ANNOUNCEMENTS and BOOK REVIEWS

Irving M. Karlin, architect, wishes to announce that he is now engaged in the general practice of architecture at 2220 East 81st Street, Chicago, Illinois.

Kem Weber, designer, has moved from 1326 Palmer Avenue, Glendale, California, to 672 South Lafayette Park Place, Los Angeles, California.

Carl R. Frye, landscape architect, is now located at 534 South Drexel Avenue, Bexley, Ohio.

George G. Miller, architect, has moved from 545 Fifth Avenue to 10 West 47th Street, New York City.

Robert S. Arnold and L. Morgan Yost, architects, announce the opening of offices in the First National Bank Building, 1150 Wilmette Avenue, Wilmette, Illinois.

Ravenna Mosaics, Inc., announces the consolidation of office, studio and showroom in the penthouse at 30-20 Thompson Avenue, Long Island City, New York.

Headquarters of the American Society for Testing Materials have been moved from the Engineers' Club Building, 1315 Spruce Street, Philadelphia, to the Atlantic Building, 260 South Broad Street, in the same city.

Edwards and Sayward are architects for the University Housing Corporation's project in Atlanta, Georgia. In the December issue of THE ARCHITECTURAL RECORD Burge and Stevens were listed as architects for this project.

CALENDAR OF EXHIBITIONS AND EVENTS

1934	
February 1	Closing date for entries for Rome Prize competition. Address Roscoe Guernsey, Executive Secretary, American Academy in Rome, 101 Park Avenue, New York City.
February 5-9	Third International Heating and Ventilating Exposition to be held at Grand Central Palace, New York City.
March 3	Closing date for receiving designs for steel tower competition, American Institute of Steel Construction, 200 Madison Avenue, New York City.
May 16-18	Sixty-sixth Convention of The American Institute of Architects to be held in Washington, D. C.
Until June, 1934	Remodeling Competition, conducted by the Good Housekeeping Studio, 57th Street and Eighth Avenue, New York City.

A. I. A. CONVENTION

The sixty-sixth convention of the American Institute of Architects will be held in Washington, D. C. from May 16-18, 1934. The general program will be arranged by the Officers and the Convention Committee. The Gold Medal awarded to Ragnar Ostberg, Swedish architect, will be presented with appropriate ceremony to Mr. Ostberg or a designated representative. The customary dinner will conclude the Convention.

MATERIALS AND METHODS OF ARCHITECTURAL CONSTRUCTION. By Charles Merrick Gay, A.B., B.S., and Harry Parker, M.S. John Wiley & Sons, Inc.: 440 Fourth Avenue, New York City. 639 pages. Illustrated. $6

The authors have endeavored to condense in a single volume the essential information concerning materials and at the same time to include modern accepted methods for their use in building construction.

The first part of the book, dealing with materials, has complete information and specifications on lime, gypsum and cement; concrete; wood; brick; terra cotta, gypsum and concrete blocks and cast stone; stone; iron and steel and nonferrous metals; floor and roof systems and fireproofing of steel; finished flooring; roofing materials, roof drainage and skylights; plaster, lath, furring and stucco; doors and windows; exterior and interior trim; paint, glass and glazing.

As all computations of structural members are based on the fundamental principles of mechanics, one chapter in the second part of the book has been devoted to a condensed treatment of this subject. Separate treatises are given on the computations involved in connection with the following: foundations; brick and stone construction; heavy timber construction; light wood framing; steel construction; reinforced concrete; and roof trusses including graphic statics.

The subject matter has been so arranged that it may lend itself to use as a textbook for classroom work, the authors having gained their experience in the desired arrangement in their work as professors of architectural construction at the University of Pennsylvania.

COLOUR SCHEMES FOR THE MODERN HOME. By Derek Patmore. The Studio Limited, London; and The Studio Publications, Inc.: 381 Fourth Avenue, New York City. 29 pages. 24 plates and descriptions. $4.50

Mr. Patmore gives his ideas on practical combinations of color, and color in relation to furniture and fabrics, and says that the understanding of color and how to use it is undoubtedly the secret of successful interior decoration. This introduction is followed by a bibliography.

The plates are mounted and reproduced in natural colors from actual interiors by popular designers of the present day. Decorations are chosen for every type of room and each plate is accompanied by a careful description and analysis.

The author cites examples of how color can be used and gives many practical and economical suggestions.

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THE ARCHITECTURAL RECORD FOR JANUARY

ERNEST BORN, ARCHITECT
DESIGNER OF COVER

NEW COVER

The cover of The Architectural Record for January starts a new series designed by Ernest Born. There will be a sequence of colors throughout the year, following the order of the spectrum. Ernest Born, the designer, is a graduate in architecture from the University of California, where he also received his Master's degree. He is a mural painter of note and has a wide experience in typography, advertising design and architectural practice.

THIS MONTH

New Housing Designs and Construction Systems. Architects and manufacturers have during the depression turned their attention to the problem of providing housing that will offer more services and utilities—a higher degree of livability—at the same time reducing original cost and expense of maintenance through more efficient construction. Some designers have sought economies through factory fabrication of the entire structure; others, through a better selection of materials and prefabrication of only certain elements, like standardized wall panels or kitchen units, without radical changes in the technique of assembly in the field. A comparison of these solutions should point the way to further development, and an illustrated survey with critical comment is given of new house designs of merit.

Panel Heating. By Alfred Roth. Search for a method of supplying desirable heat without radiators or exposed pipes has led to the innovation of panel heating. Heating pipes are embedded in the ceiling or attached panels. The system works by radiation, eliminating high room air temperatures.

Aetna Life Insurance Company Building, Hartford, Connecticut. James Gamble Rogers, Inc., architects. The site being relatively inexpensive, it was possible to design for as much daylight as could be achieved without departing from the architectural tradition of a New England city of Colonial origin.

FEBRUARY ISSUE

The February Architectural Record will illustrate the major housing developments advanced by the PWA. There will be as complete a showing of these projects as possible. It is our belief that the methods in housing design developed by architects during this emergency period will serve as a guide for future architectural practice.

Shopping Centers, by Clarence S. Stein and Catherine K. Bauer, is a study of the local store for dispensing merchandise. The survey includes data on approved sizes of stores, location, quantity (number and kinds of stores), and form (arrangement).

THE VINYLITE HOUSE . . .

an experimental research project to show the versatility of Vinylite, a plastic material developed by Carbide and Carbon Chemicals Corporation. A three-room apartment has been built with factory-fabricated sectional wall panels of molded Vinylite. (These panels are experimental only and have not yet been put into commercial production.) Floor tiles, the doors and door knobs, the extruded ceiling molding and baseboard, and incidental items like vases and cigarette boxes are of the same material. The illumination is transmitted through translucent sheets of Vinylite about 0.0625 inches thick, which have a light transmission value of more than 90 per cent.

Vinyl resins are colorless, odorless, tasteless, noninflammable, and may be colored any shade with dyes or pigments. The pure resins are transparent but any degree of opacity can be attained by incorporation of fillers. Since the resins are permanently thermoplastic, molding is a comparatively simple operation. Because of low shrinkage, very large objects such as doors or wall panels can be molded easily. Metal, wood, composition board and similar products may be completely surfaced with a tough, stable and chemically resistant protective coating.

THE VINYLITE HOUSE . . .

(Description on over-page)

THE ARCHITECTURAL RECORD

JANUARY, 1934 VOLUME 75—NUMBER 1

NEW HOUSING DESIGNS and CONSTRUCTION SYSTEMS

Compiled by C. THEODORE LARSON

The housing problem has become one of offering more services and utilities—a progressively higher standard of living—while at the same time reducing the original construction cost as well as the expenses of maintenance through a more efficient building technique. Designers and manufacturers have approached the problem in different ways—some by seeking economies through factory fabrication of the entire structure; others through a better selection of materials or through prefabrication of certain parts, like standardized wall panels or combined kitchen and bathroom units; still others through a better utilization of space inside the house or through the inclusion of an increasingly greater number of household conveniences. Numerous such designs have already appeared as actual demonstrations, and many more are being developed on the drafting boards. In the belief that a comparison of these proposals may point the way to further experimentation, THE ARCHITECTURAL RECORD presents in the following pages, in addition to reports of various research activities, an illustrated review of some recently developed designs and structural systems. The descriptions are from information supplied by the designers and manufacturers.

RESEARCH FINDINGS OF BEMIS INDUSTRIES, INC.

By JOHN BURCHARD II, Vice-President

For upwards of a decade Bemis Industries, Inc., Boston, has been engaged in housing research with a view to producing individual houses more cheaply. During that period we have operated laboratories and through our subsidiary, Housing Company,* have yearly (until the last two years) built houses to test the methods which we have developed. During that period we have built houses embracing 22 different types of construction. We feel confident that over this period we have spent more time and money and effort on the problem than any other single organization in the United States. Our various constructions have reproduced to a surprising degree the basic principles now being urged by our more vociferous contemporaries, and for one reason or another we have given up most of these principles.

In spite of all this research we are unable to present today the plan, elevation and structural drawings of a house which we can offer and of which we can confidently predict that it will be a good buy for the customer and a profitable undertaking for us. Perhaps our long and not always happy experience has made us a little cautious. Perhaps we feel that some of the newcomers are in for disillusioning experience with their early leap into commercialization.

Our houses (see accompanying illustrations) may appear unduly large and not fitted to the income

*Housing Company is the outlet for the direct commercial exploitation of the ideas originated by Bemis Industries, Inc., which is primarily a management and operating company paying for all research and owning the patents.

EXPERIMENTAL HOUSES

1925 HOUSE—WALTER PHILLIPS ESTATE
WELLESLEY, MASSACHUSETTS
GUNTHER AND BEMIS, ARCHITECTS

1926 HOUSE OF HARVEY L. DONALD
WALTHAM, MASSACHUSETTS
HOUSING COMPANY, ARCHITECTS

1927 HOUSE OF MRS. MARY HALLORAN
WALTHAM, MASSACHUSETTS
HOUSING COMPANY, ARCHITECTS

group for whom I presume we are all working. The reason for this lies in our method of research.

Our program for some time has been as follows: A scheme has been developed to a considerable extent on paper; we have then taken it into the laboratory and built full-sized sections on which we have made exposure, strength, fire, sound and insulation tests. If the intimations of these were favorable, we have then built a house with our own money. Since we hoped afterwards to sell this house we have tried to build houses of a type and in localities where they would find a ready market. It would scarcely be expected that we could build houses designed on a mass production principle very cheaply at the outset when the desired mass production was not available. Consequently we have sold our completed houses at the current market and the loss, if any, was the cost of research.

In our opinion there is no other way of testing a proposed house construction satisfactorily. A bona fide house must be built. And moreover we feel that a serious investigator will build the house with his own money and not with a customer's. Our customers have had a chance to see what they were getting before they bought, to buy at a favorable price, and the houses have been serviced after construction to a point which I think excessive, in order not to destroy the least vestige of good will.

Our research program still follows the same general lines. To it we have added the step of model building, between the drawing stage and the laboratory stage. These models are carefully made in the laboratory with precision machinery and they often show up a defect in planning of the construction which otherwise would not be detected before the actual building was built. Typical wall sections are the easiest things in the world to draw and build. Any fertile-minded person could evolve ten or twenty a day. In laboratory tests of properties one usually deals with typical sections. But the most astonishing thing about typical wall sections is that they are not typical. The big problems of prefabricated housing come in joints, corners, wall intersections and openings, and these often come to light in the course of model making much more clearly than they do on paper.

I think I can honestly say that it is the ambition of this group to produce a house or houses (by that I mean constructions and not a single plan) which can be sold for less money than houses built in the conventional manner, with a view primarily not to profit for us but to ameliorating the housing conditions of the lower-income groups. But we are firmly convinced that under our present economic system no pro bono publico venture of this sort is worth anything unless it can demonstrate its ability to make a profit, however small. If our scheme or any other is such that no private initiative would be interested in it we cannot feel it to be a sound thing for public initiative.

BUILT BY BEMIS INDUSTRIES, INC.

1928

HOUSE OF FRANK G. AKERS
DEDHAM, MASSACHUSETTS
GUNTHER AND BEMIS,
ASSOCIATES — ARCHITECTS

1929

HOUSE OF MRS. B. C. ELLERY
BROOKLINE, MASSACHUSETTS
GUNTHER AND BEMIS,
ASSOCIATES — ARCHITECTS

Photos by Paul J. Weber

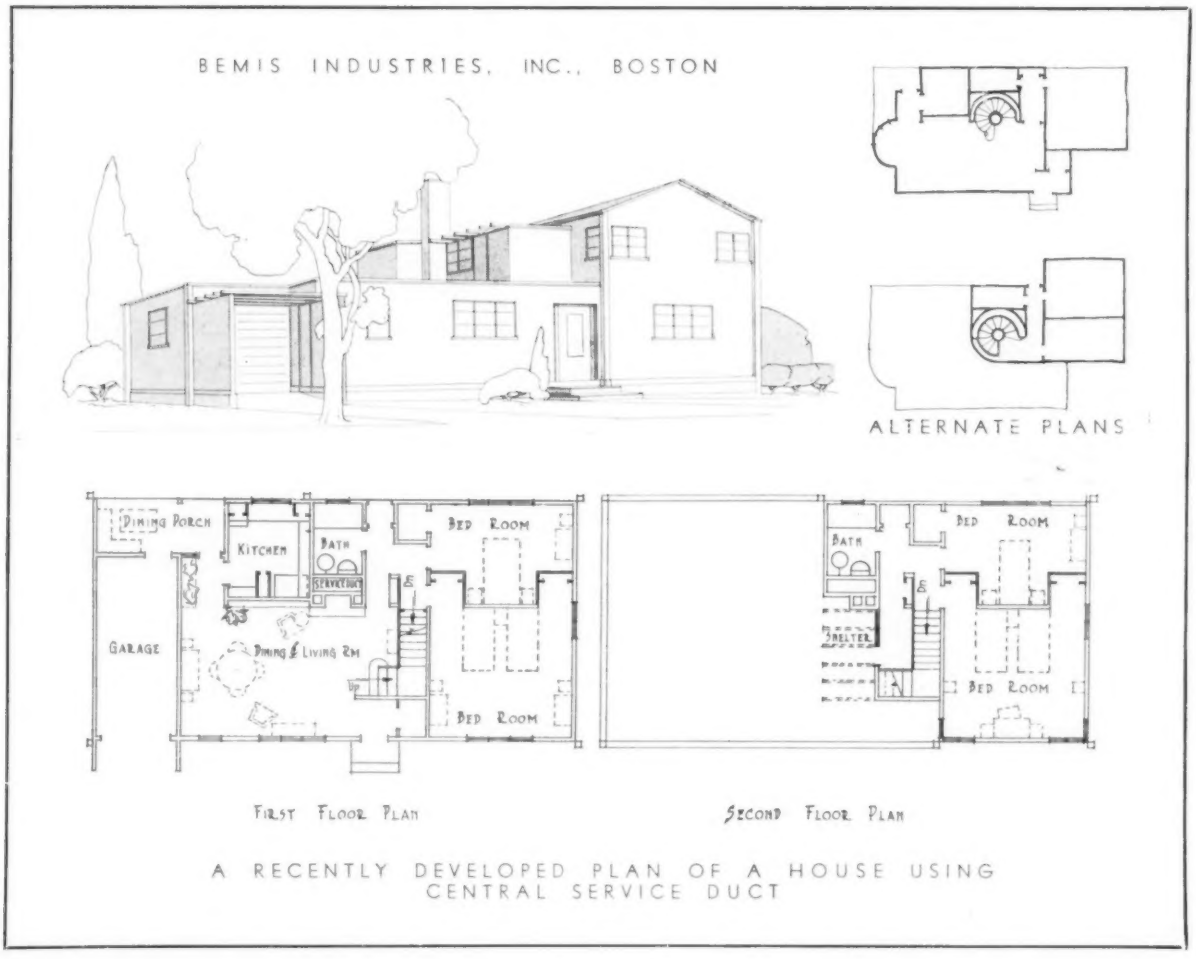
Historical Development

With this background I shall briefly sketch the work we have done over the past ten years:

1923-24. We built houses in Wellesley, Massachusetts, and South Tamworth, New Hampshire, as well as a dormitory for the Massachusetts Institute of Technology, with a scheme of which the basic principle was the premanufacture of built-up panels of wood extending story height with certain joints poured with concrete. This was a sort of self-forming scheme. It is still our conviction that where concrete or other cementitious materials are to be used structurally in a building the structure should be self-forming, that is, there should be no necessity for reclamation of valuable materials.

1925. We built three houses in Wellesley, Massachusetts, each slightly different. The broad idea, however, involved a light self-aligning steel frame for positioning only. Certain horizontal members of this frame served later for reinforcing for poured concrete floor beams. Precast gypsum blocks were used for walls and precast gypsum slabs 2 inches thick (see Fig. 1) spanned precast gypsum panels which were later filled with concrete to form the structural joists and also to bond the slabs together. Again here is the idea of self-forming of the structure together with the new conception of a positioning frame.

1926. The thin steel frame of a size which we could afford to use appeared perhaps not rigid enough properly to position members, so we developed in this year a gypsum tube 4½ inches in diameter and positioned our wall slabs on these tubes (see Fig. 2). Moreover we worked in the direction of lightening the slabs and produced an excelsior-magnesite material earlier than the Stockade block. This material has developed into our commercial material Acoustex. Some of the spaces between the tubes were poured. So again we had the aligning type of structure with self-containing



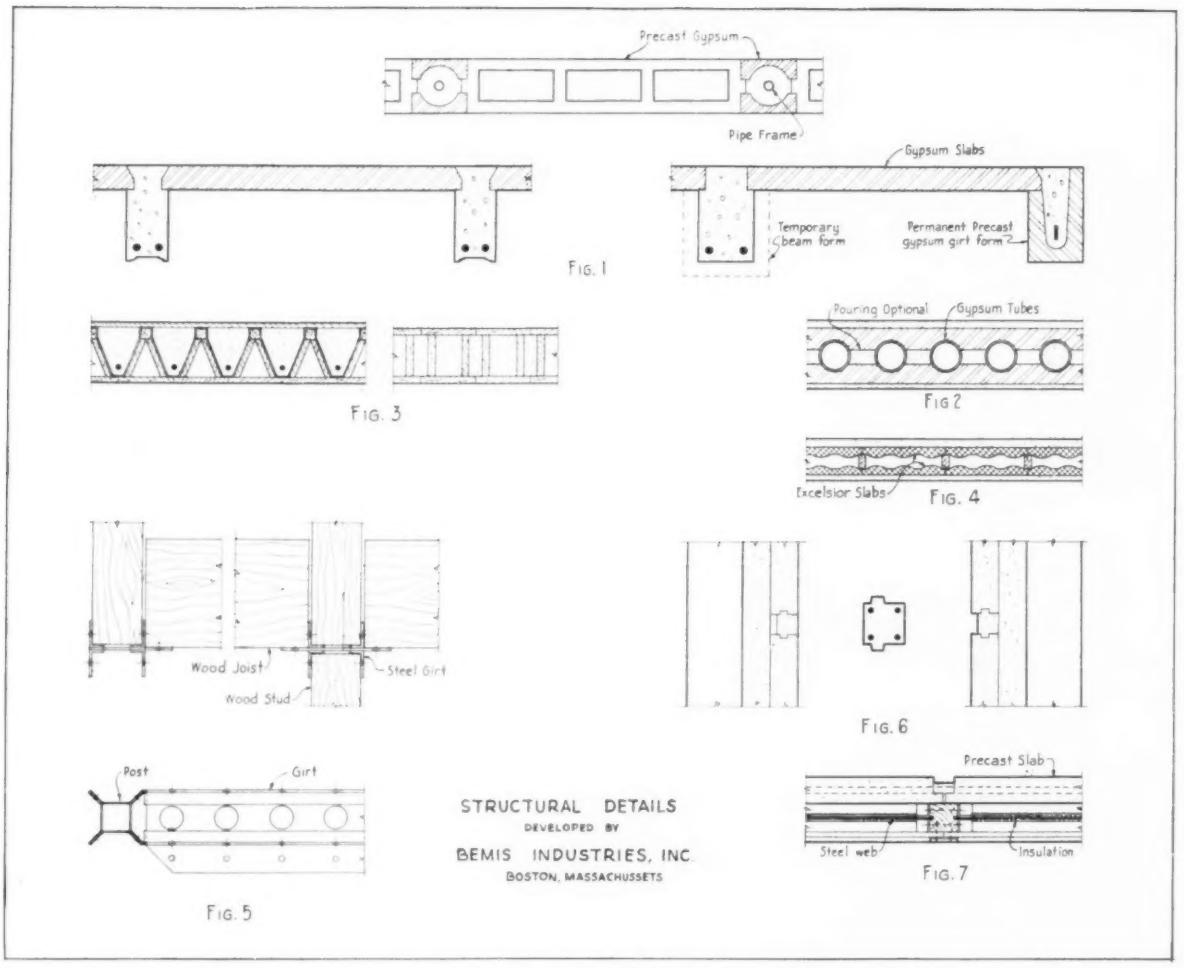
A RECENTLY DEVELOPED PLAN OF A HOUSE USING CENTRAL SERVICE DUCT

concrete forms. Here for the first time we achieved a small degree of prefinish with results that were not wholly satisfactory. Horizontality was the feature of the slab treatments of 1925 in Wellesley and of the six houses built in 1926 in Waltham, Massachusetts.

At the same time, however, in Hampton, Virginia, we embarked on a different approach, the beginning of what we call our Beamy-style system. In Hampton the wall units were of wood or of wood and Celotex of the cross section shown in Fig. 3. These were of wall thickness and of story height. Registering with the openings between them were openings between floor members of this cross section. These spaces were poured. The faces of the units were in some cases prefinished. Again this is the idea of self-forming members, but the story height principle is now added. There was no metal in these buildings other than the reinforcing necessary in certain floor joists. These houses were completed in—

1927, when we also built at Waltham two small houses of a Beamy-style type. Here we abandoned the gypsum tubes, built up story-height panels of considerable width (2 feet) with a slab of Acoustex on each side attached to two wooden vertical strips (see Fig. 3). The floor of these houses was conventional. The roof was slabs of Acoustex overlapped and covered with asphalt and slate chips to produce a roof looking marvelously like thatch, very inexpensive, and apparently very durable. Joints of the walls were poured with concrete. These houses were inexpensive but embraced too much conventional construction in floor and roof framing to seem attractive to us for a long pull.

1928. In this year we began the use of a steel frame which we have since marketed with more or less success under the name of the "A" frame. The frame was intended to serve as an aligning frame for our ultimate Beamy-style units. (We knew that in the long run we could not afford to build up Beamy-style units synthetically as we had done in the previous years, but in 1928 we had not yet developed a truly preformed and homogeneous Beamy-style unit. We were experimenting extensively in this field, however, largely with casting. The casting processes did not ultimately prove successful. At the same time we were trying to extrude wood pulp, but this also failed. Consequently the year found our frames but not our units ready.) We tried out the frames in four houses, two in Dedham and two in Wellesley, and later had orders for some others in the same towns. The frames were characterized by a girt of the



cross section shown in Fig. 5, the protruding plate being used to support floor joists. The frames in these houses were used with precut wood studs and joists and due to the repetitive punching of the holes in our steel members no rulers were needed and the framing was accomplished very readily. Sufficient steel studs and corner posts were used so that the steel could be erected first. This frame was not expensive as frames go. It was a marvelous method of aligning members. It produced a first-class wood frame house. But again it showed no ultimate process and we never regarded it as more than transitional device.

1929. Meanwhile we were working with other steel frames and had cheapened our process of making Acoustex to the point where when appearance was not necessary we could use it as an insulating slab. Accordingly, in 1929 we built an elaborate and somewhat modern house in Brookline, using a different type of frame with premade insulating panels. At the same time we returned to the always appealing idea of precast cementitious units with a new self-keying slab scheme which used 2-inch grooved slabs and long precast reinforced aligners with tongues on them (see Fig. 6). These slabs were keyed to the steel frame and formed a prefinished exterior and in one or two cases a prefinished interior as well, gypsum being used inside. The posts were poured. Here we had combined the idea of the steel frame with the vertical story-height Beamy-style units (in the form of insulating panels) with the horizontal earlier cementitious treatment and the bonding by pouring. The house cost too much and we think it always would.

1930. In this year we arrived at what we call a plate girder type of construction. Our Beamy-style units became panels of steel with a central web and angles around the edges, all quite small. These were fastened to girts and posts of similar cross section. Adjacent panels were jointed by a wooden asphalted strip with a saw kerf longitudinally into which the webs of the panels fitted, these webs projecting slightly beyond the back of the angles as shown in Fig. 7. We used our 1929 slab treatment on the outside and various self-keying panels on ceiling and walls inside. We allowed joints to show and attained a considerable degree of prefinish. If we had not covered the panels on the outside but had merely covered the joint with a U-shaped member we would have been pretty close to General Houses' Elmhurst scheme except that our panels were much more completely automatic.

This house showed a great deal of promise, but then came the depression and like most other organizations we had to draw in our horns somewhat.

Recent Developments

During the past three years we have consolidated this information and made a number of new developments:

(1) We have developed the manufacture of story-height wall units in pulp to a cheap and successful conclusion. The method is new and is patented. By it we can cast blocks of pulp up to 20 feet high, up to 4 feet wide, up to 9½ inches thick. A standard panel for our purposes would be 2 feet wide, 4 inches thick, and story height. We have worked with considerable success on prefinish of this panel which has a very high insulating coefficient (about 0.09 B.t.u.). We have succeeded in bonding metal to it and have also achieved interesting results with paints and synthetic resins.

(2) We have developed a self-keying partition using gypsum or transite wall boards in combination with a very simple steel stud which shows great promise not only for partitions but also for a simple exterior structure.

(3) We have developed a self-forming structure of burlap or of thin-gauge metals which is used for foundations and in which considerable economies can be effected where concrete walls are necessary.

(4) We are working on a new type of wood structure, not to replace our prefabricated structures but to occupy an entirely different field.

(5) In the field of materials we are most interested in applications of synthetic resins, in plywoods, and particularly resin-bonded plywoods, and in the new developments in Robertson Bonded Metal.

(6) During the past two years we have been supervising the publication of a three-volume work, "The Evolving House." The first volume dealt with *The History of the Home** and was by A. F. Bemis and the writer. The second volume, now on the press, deals with the economics of present-day housing and is by Mr. Bemis and Luther Conant. The third volume, on a method of rationalization of the industry, is in preparation by Mr. Bemis and should appear in 1934.

Immediate Program

We offer no house for sale today. We shall continue to push our research, confident that we are near a solution. In the spring we shall probably build houses embracing the new principles and adhering to those old ones which are tried and tested. It is quite likely that we shall supplement this with a series of model demonstrations perhaps under the auspices of a new corporation, Evolving House, Inc.

Our fundamental objective is better and cheaper housing on a self-supporting basis. We are committed to the exploitation of no individual material whatsoever. We have large numbers of patents in the housing field, many of them basic, and we will license these under proper safeguards to responsible parties. Whether or not we shall ever manufacture parts for ourselves cannot be stated now. Our inclination is that the house producer should not himself make the parts and certainly should not do the financing. We might even go farther and license others to do the house producing, reserving for ourselves the joys of experiment, development and education.

The backbone of all our planning, and basically patented, is the cubical modular system of design. This method is applicable even to conventional structures but applies with particular force to all forms of prefabrication. We are ready to license under this patent and believe that by such licenses the current factors in the housing field will profit both in improvement of their own product and in the cooperation they will obtain from other licensees. This system is really extraordinarily simple and beneficial. It will be explained in detail in Volume III of "The Evolving House."

Experience indicates that one of our principal structures over the next few years will be along the lines of Beamy-style—i.e., a prefabricated wall or floor unit containing its own finish, insulation, and structural strength.

We believe in the elimination of water on the job if possible, but have a convenient forming scheme when poured materials are really necessary.

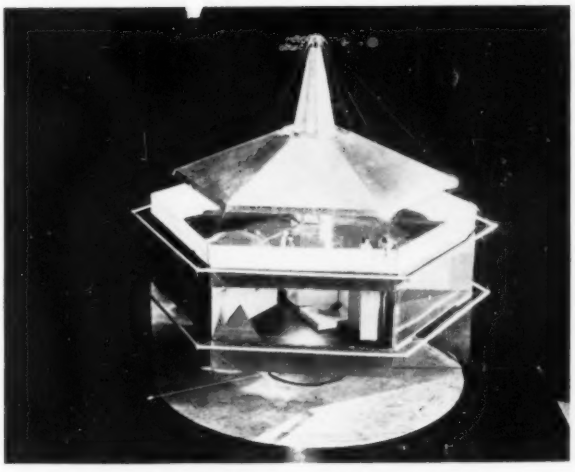
We shall continue to aim for the highest degree of factory manufacture as opposed to site manufacture and believe this necessitates integral finishes.

We shall continue to try alternative schemes until one proves clearly best. We are not in the business of trying immediately to commercialize one scheme before we know its faults and merits completely and to the exclusion of alternative schemes.

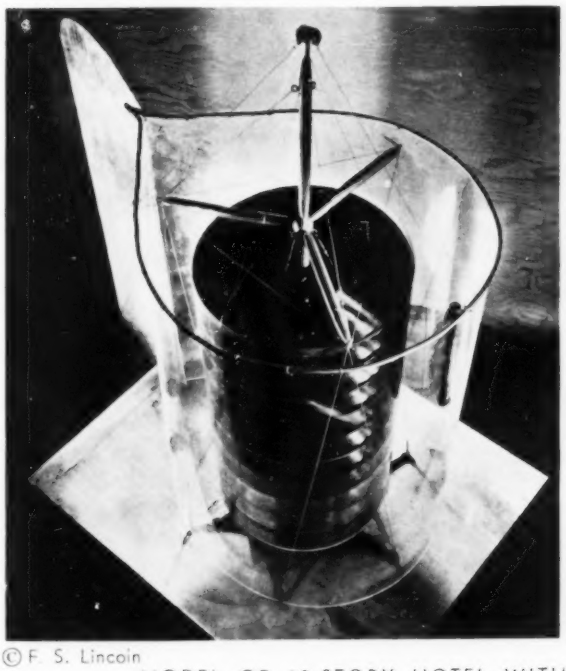
We think there is a good deal of merit in the central duct system, i.e., a modification of the Fuller and Bowman idea for handling services in a house. This is incorporated in a recently developed plan of a rather large modern house, which is illustrated on page 6, together with an alternate plan which we consider more attractive but probably not quite so suitable for mass production.

We believe housing in the United States will best be fostered not by the presentation of three or four or even twenty models of houses but by a system of planning and design which permits each and every buyer to have his own plan and design while using premade parts similar to those used by others. Our cubical modular system starts from this and our structures must conform to the criterion. We recognize that in commercial practice certain plans may be so good that they will merit repetition.

*Ed. Note: This volume is published by The Technology Press, Massachusetts Institute of Technology, Cambridge, Mass.; 534 pages, illustrated; price $4.

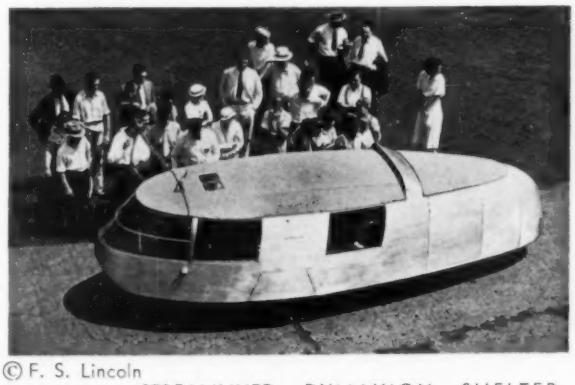


1929 MODEL OF DYMAXION HOUSE, SHOWING CENTRAL UTILITY MAST AND SUSPENDED FLOORS. (FIRST DESIGN: 1927)



© F. S. Lincoln

1932 MODEL OF 10-STORY HOTEL WITH REVOLVING STREAMLINED SHIELD FOR AIR CONDITIONING CONTROL



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1933 STREAMLINED DYMAXION SHELTER-MOBILE FOR LAND CRUISING—BUILT AT BRIDGEPORT, CONN.

DYMAXION HOUSES

AN ATTITUDE

By BUCKMINSTER FULLER

Reasonable persons have conceded the realization of the Dymaxion House within periods ranging from 10 to 100 years while the ultra-Tory dealing lavishly in thousand year units has tossed it lightly ages ahead or even into never-never land.

In July 1932 FORTUNE Magazine published a comprehensive stock-taking of the industrially-to-be-reproduced house. In the article there was considerable discussion of the principle involved in the designing of the Dymaxion House. A specially illustrated two-page spread in color was included in the article designed to show Dymaxion Houses in natural settings that the readers might visualize these otherwise theoretical structures. FORTUNE's editors were eager to have their readers envision the Dymaxion House or its progeny as a plausible article to be reproduced within a reasonable number of years.

The above event is recited to provide a characteristic example of popular or even specialized ability to forecast for there was involved an interesting anecdote. When FORTUNE had determined to illustrate the Dymaxion House in attractive color setting as above related they employed an artist skilled in the presentation of mechanical objects such as automobiles and boats. The artist held lengthy and detailed discussions with the designer of the Dymaxion House and acquired an excellent knowledge of its many details. He prepared and submitted his illustrations to FORTUNE. FORTUNE was pleased with the illustrations, but with one exception. Automotive vehicles were shown in the drawing like none they had ever seen. They were purely streamlined fishlike forms. The editors instructed the artist to remove these "incredible vehicles" from the picture and substitute everyday automobiles, fearing that the display of the former would tend to discredit the Dymaxion Houses, deemed indigestible enough. The designer of the Dymaxion House on hearing of this conferred with FORTUNE and explained that the automotive vehicles first in question were part and parcel of the original Dymaxion design, as every Dymaxion House was to have its transport unit just as yachts have their small boats, and that these truly scientific vehicles were quite as timely for popular usage as the Dymaxion House. "No," said FORTUNE, "while architecture, we will concede, is 2,000 years behind general industry, the automotive world is far advanced and we will not concede that your revolutionary design is as valid in the automotive world as your houses in architecture." That was July 1932. By July 1933 the second Dymaxion car had been finished and at the present writing industry is hastening its quantity reproduction. It is a proven and popular unit

DYMAXION TRAFFIC CHART

This illustration is a reproduction of a drawing from "Time Lock," a book written and illustrated by Buckminster Fuller in 1927. It illustrates the town plan for which Dymaxion shelters were designed. The Dymaxion shelters shown thereon indicated the author's notion of the areas of high future importance, for with the production of highly transportable scientific shelters the Arctic Circle and the Tropics may be readily developed as regular air courses. As the author writes: "When the illustration was made in 1927 the routes involved were deemed fantastic as was also the colonization of the Arctic Circle by Russia, indicated by the Dymaxion Towers. Today the subject matter is so much a matter of fact as almost to preclude its publication except as a vivid reminder that the portion of the human family which has believed in and striven for the 'new deal' in its comprehensive form is not long to be kept waiting."

Chart statistics: 26% of earth's surface is dry land; 85% of all earth's dry land is here shown; 86% of all dry land shown in above equator. "The whole of the human family could stand on Bermuda; all crowded into England they would have 750 square feet each."

with almost twice the efficiency of the traditional automobile. FORTUNE, an acknowledged modern, could not see one year ahead, even though declared friends of Dymaxion.

Theoretically the two world air routes most recently coursed by the Lindberghs, i.e., to the Orient and Russia via Alaska, and to Europe and Africa via Greenland and Iceland, were evident to the world-considerate architect years ago and academic to the scientifically minded for some time past, yet until Lindbergh had actually landed at the New York Airport on December 19, 1933, having jauntily traced and retraced his routes, was a notion of popular transportation by air over the pioneered track conceivable? It takes material demonstration to win popular credence of scientifically-arrived-at theory. This factual accomplishment derides Nationalism.

The Dymaxion House is still as it has been for years—a theory only. Despite pragmatic criticism it has conscientiously been kept so. While theoretical it is immediately improvable by every scientific advance. Its monthly improvements and inclusions are vaster than the yearly refinements and inclusions in the autmotive world, as it has never been burdened with "overhead" nor with heavy industrial-investment earning-requirement.

The Dymaxion House rather than being a fixed solution has been naught but a statement of the problem, progressively satisfiable in the latest manner.

It might even be more broadly stated that the Dymaxion House has been merely an attitude. An attitude of willingness to think truthfully. To think truthfully of the general problem of life's survival and its potential solutions in the terms of the latest achievements of the intellect, quite unfettered by history's relatively temporary national, political and aesthetic bonds. Such bonds are not habits of thinking but habits of not thinking. Dymaxion Houses may be conceived of as progressive composites of the best means of living as determined by universal survey.

Dymaxion shelters are germane to the emergent scientific (as opposed to political) socialism. The first full-sized research and demonstration of Dymaxion Houses requires probably an expenditure of millions of dollars. Millions of dollars have never been accreditable to the large army of designers and craftsmen now qualified to make the demonstration. The social implications of Dymaxion Houses have eventually rendered them non-supportable to profit-minded private capital in each instance of past consideration. It has long been evident that demonstration sufficiently uncompromised to be successful could only be accredited by government subsidy. The central object of this article is the reasonable prediction that out of the fourteen billion dollar sum now contemplated for building (in its many departments) through government credit, there will soon be apportioned an adequate amount to underwrite the scientific development of shelter. The sore want of such

underwriting must be evident in the answers to the questionnaire which THE ARCHITECTURAL RECORD has put out covering this subject.

It is worth remarking that at present the chief obstacle to such Federal underwriting of scientific shelter is the current espousement of the Public Works program by the organized revivalists of the multitudinous obsolete activities inherent in the tailored building of past land exploitation dominance, abandoned to death in its sleep by decentralizing scientific industry.

The items of the questionnaire sent out by THE ARCHITECTURAL RECORD to provide an able survey of the advance into the everyday industrial world of a Dymaxion attitude constitute an approximate list of the questions employed by Dymaxion designers since the conception of the idea. They were known as "universal conditions of reproducible shelter."

How much do houses weigh?

What is the specific longevity of the structure? of the entire shelter composition and its mechanical constituents?

What is the specific longevity of the structure?

Is the design to be sold or to be an incidental instrument of a service to be rendered such as a universal hotel and travel service might provide?

To THE ARCHITECTURAL RECORD'S questionnaire might be added a question: "Does your design emphasize life or death?" This question should not be interpreted in the aesthetic manner: "Is your architecture living or dead?" When in time ideas materialize sufficiently to be called architecture they are inevitably dead. Architecture is finite—life infinite. Maybe life is an idea—an idea that truth is progressively delightful.

1918 DEMONSTRATION GROUP 48
FOREST HILLS GARDENS, LONG ISLAND

Among the earliest examples of standardized unit construction are a series of group houses built by Grosvenor Atterbury in New Jersey and Long Island, beginning in 1907. Precast wall, floor and roof sections, composed of different materials, were assembled on the site. In this case concrete was used and the units were hoisted in place by means of a crane.

STANDARDIZED UNIT CONSTRUCTION

GROSVENOR ATTERBURY, ARCHITECT

COMMUNITY PLANNING WITH TRANSPORTABLE HOUSES

By TEMPLE HOYNE BUELL, Architect

Land is available in almost unlimited quantities along our main highways and within a radius of 20 miles of our cities that can be purchased for $200 an acre or $40 a site. At this figure an owner could rent a site for $8 a year and return the farmer 20 per cent gross on his land which is more than could be got by raising crops.

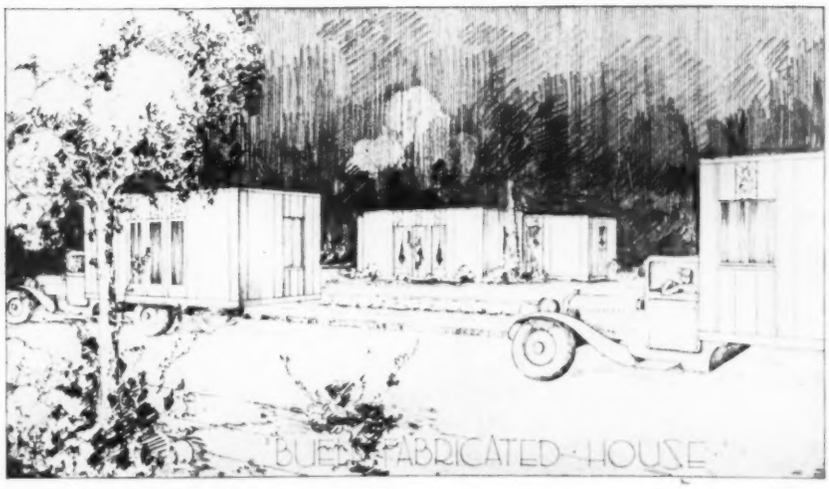
The rental of the site would have an advantage in that if the owner did not like his neighbors or should work become scarce in the neighborhood, he could have his house easily moved to another site. An owner of a standard house could thus become practically independent of the landlord. He could have his own garden in which to raise vegetables and flowers about his home. He would be able to purchase, direct from the farmer from whom he was renting a site, such farm or dairy products as he himself is incapable of producing, at a figure greatly reduced below what he must pay for them in the city. The produce would be fresher and, because no middle man would be involved, would return the farmer more than he is now accustomed to receive.

Every one would, by being less congested and the population as a whole less centralized, be able to live freer, cleaner and healthier lives, and the nation would benefit in that there would be developed a much stronger and sturdier race.

BUELL FABRICATED HOUSE SYSTEM

DENVER, COLORADO

T. H. BUELL & CO.
ARCHITECTS



Actual production has not yet begun, although small-scale working models have been prepared.

Occupancy: parents and either a child or an elderly person. Additional units can be added to provide for more occupants.

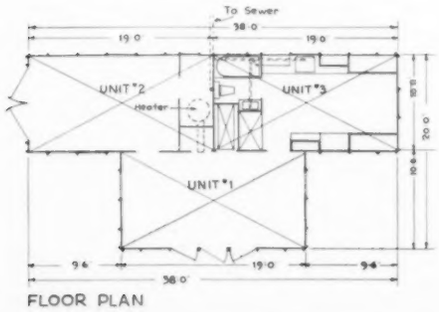
Cost: $1,200, delivered to the site, "when manufacture and distribution shall have approximated one-half the efficiency in production evidenced in the automotive field." Maintenance would depend on location, but would be far below usual expenses. Present plans call for methods of manufacture, distribution, sales, delivery and finance similar to those employed by General Motors Corporation.

House designs are intended to have every available labor-saving device. New products and equipment to be incorporated in succeeding yearly models.

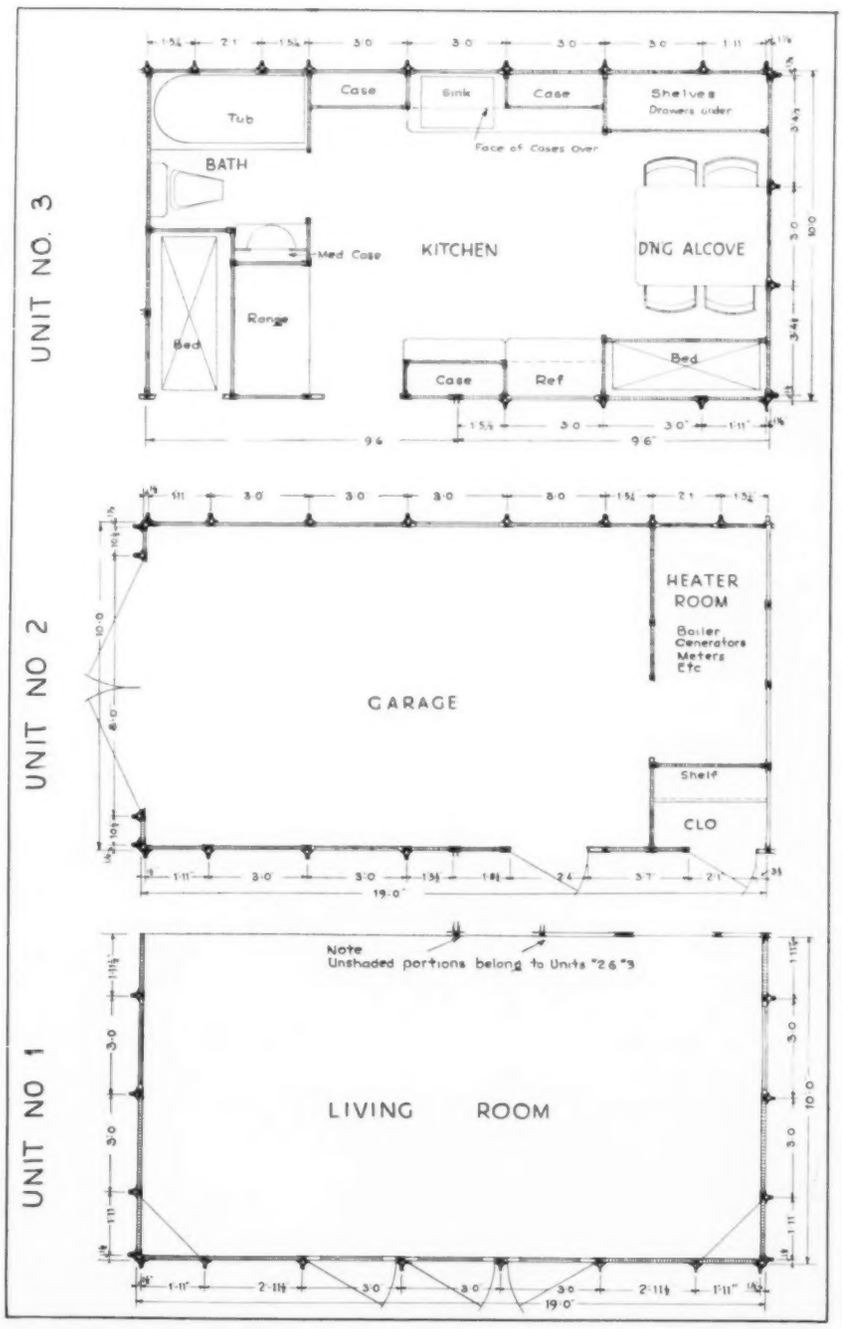
Air conditioning equipment to provide heated or cooled, humidified, filtered air. Atmospheric circulation by a fan system driven by the motor which generates the required heat through resistance coils.

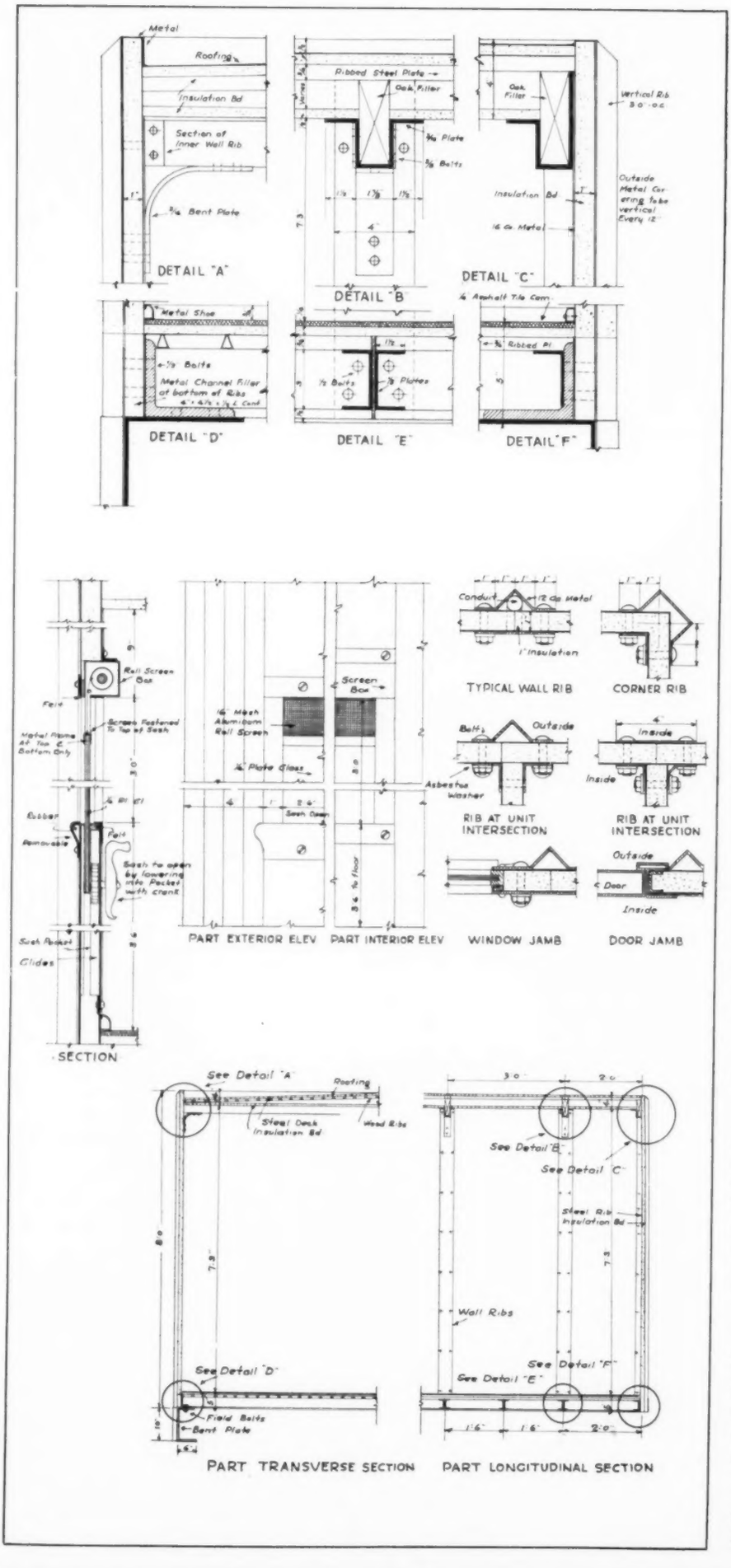
Illumination: both direct and indirect. Current from a generator in the dwelling itself.

As much furniture as possible is built into the interior design. All furnishings, bedding, dishes and utensils of every variety needed for immediate housekeeping included in purchase price and delivered with the house.



FLOOR PLAN





BUELL FABRICATED HOUSE SYSTEM

DENVER, COLORADO

T. H. BUELL & CO.
ARCHITECTS

All services and utilities to be provided, except water connection and sewage disposal. Where facilities are not provided by the municipality, accessories can be purchased so as to make the unit self-sufficient. Small garbage disposal plants available for country use.

Structural system: metal frame throughout. Exterior metal wall surface designed to care for expansion and contraction. Interior wall surfaces of metal with provision in design for ducts, conduits and pipes. Metal floors with manufactured covering. Metal roof similar in construction to automobile top.

Structural values: being practically fire-resistive, house should carry more favorable insurance rating. Being a structural entity in itself and requiring no prepared foundation aside from a level piece of ground, house would be unaffected by earthquake. Materials immune to attack by insects. Moisture filtration negligible. Thermal insulation by means of a crushed noncorrosive metal filler between exterior and interior wall surfaces.

Weight: approximately 3 pounds per cubic foot.

Construction entirely shop-fabricated. Approximately 24 man-hours required for assembly on site. Trucks carrying individual sections to the location will be supplied with cranes capable of lifting each section and setting it in its proper place, after which the units will be bolted together. As soon as furniture and dishes are unwrapped and fuel put in motor, the house can be occupied.

Outmoded or damaged units can be replaced, or others added, with no greater expense or inconvenience than required in setting up original structure. Expected life span of house: 5 to 10 years, depending on financial independence of owner. Demolition in less than 20 man-hours.

Potential salvage value would be approximately that of worn-out automobile which is taken in trade on a new model.

STRAN-STEEL HOUSE

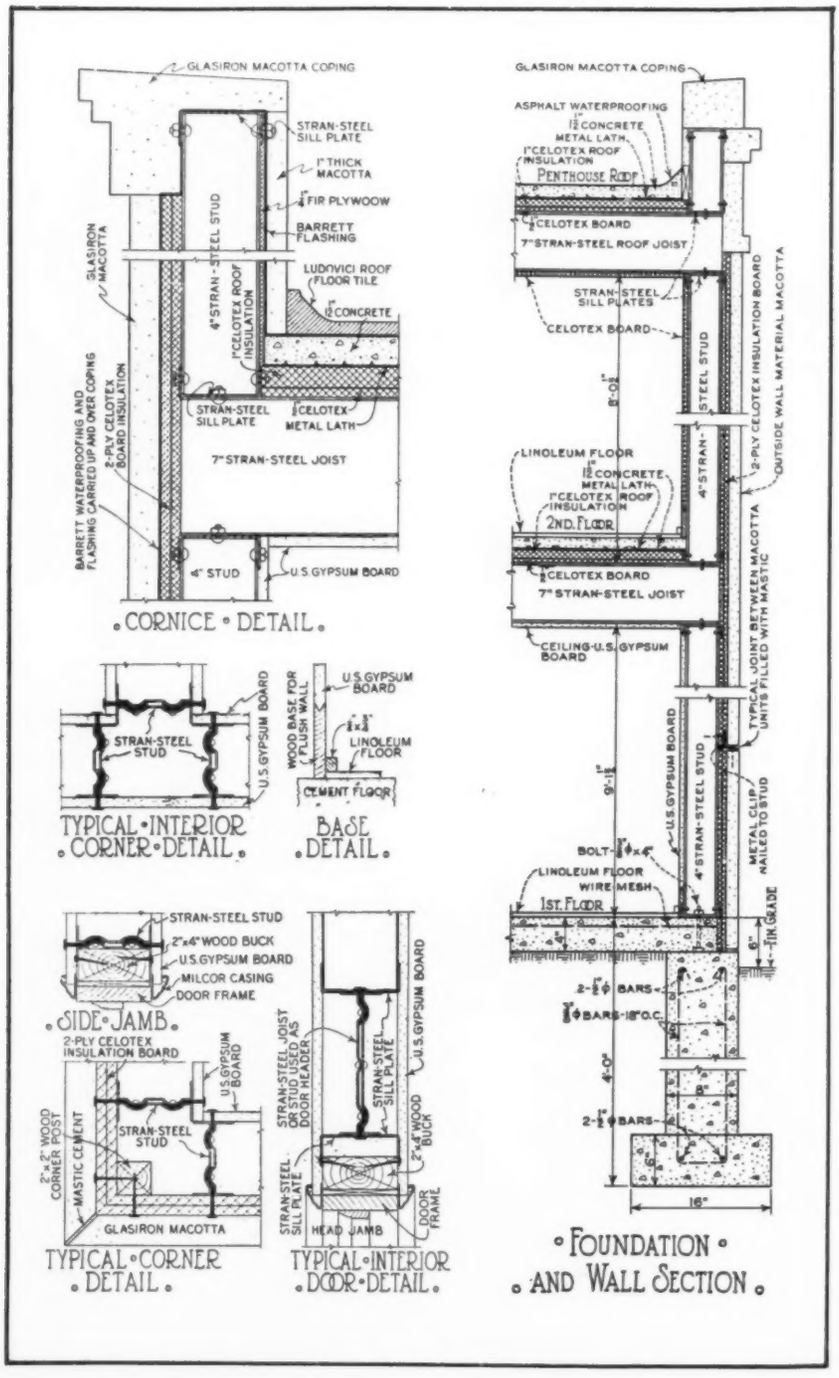
CHICAGO WORLD'S FAIR — 1933

STRAN-STEEL CORPORATION
AND GOOD HOUSEKEEPING

O'DELL AND ROWLAND, ARCHITECTS
DWIGHT JAMES BAUM, ASSOCIATE

Kaufmann-Fabry

COST OF DUPLICATION: $9,000, CHICAGO PRICES



FIRST-FLOOR-PLAN

According to manufacturer: "Not a prefabricated steel house, but a system of steel members which replaces wood joists and 2" x 4"s. All the well-known collateral building materials are nailed to Stran-Steel just as they are nailed to wood lumber."

Stran-Steel consists of 2" x 4" studs and rafter, 2" x 2" joists, and connections of 16- and 13-gauge steel, formed and riveted so that a nailing groove runs lengthwise on two sides of each stud and joist. When building materials are nailed to these members, the nails follow the sinuous shape of the groove and clinch themselves firmly into place.

The exterior of the Century of Progress house is covered with Glasiron Macotta slabs, 1¾" thick, 2 feet wide and from 2 to 8 feet long. This material consists of a layer of lightweight Haydite covered with thin-gauge steel which has a weather-resisting coat of porcelain enamel. After 1" Celotex insulation has been nailed to outside of steel framework, the Macotta is nailed on by means of right-angle metal clips and the joints are sealed with mastic tape. No plastering and no water used in construction except in laying concrete floor slabs.

COLUMBIAN HOMES

COLUMBIAN STEEL TANK CO.
KANSAS CITY, MISSOURI

This company manufactures two types of steel buildings:

(1) Standard Framework Type, developed more than 20 years ago and now in use for pump houses, warehouses and general commercial utility. Construction: angle framework supports bolted wall sheets and unit-welded steel trusses with purlins support roof sheets; all standardized sections.

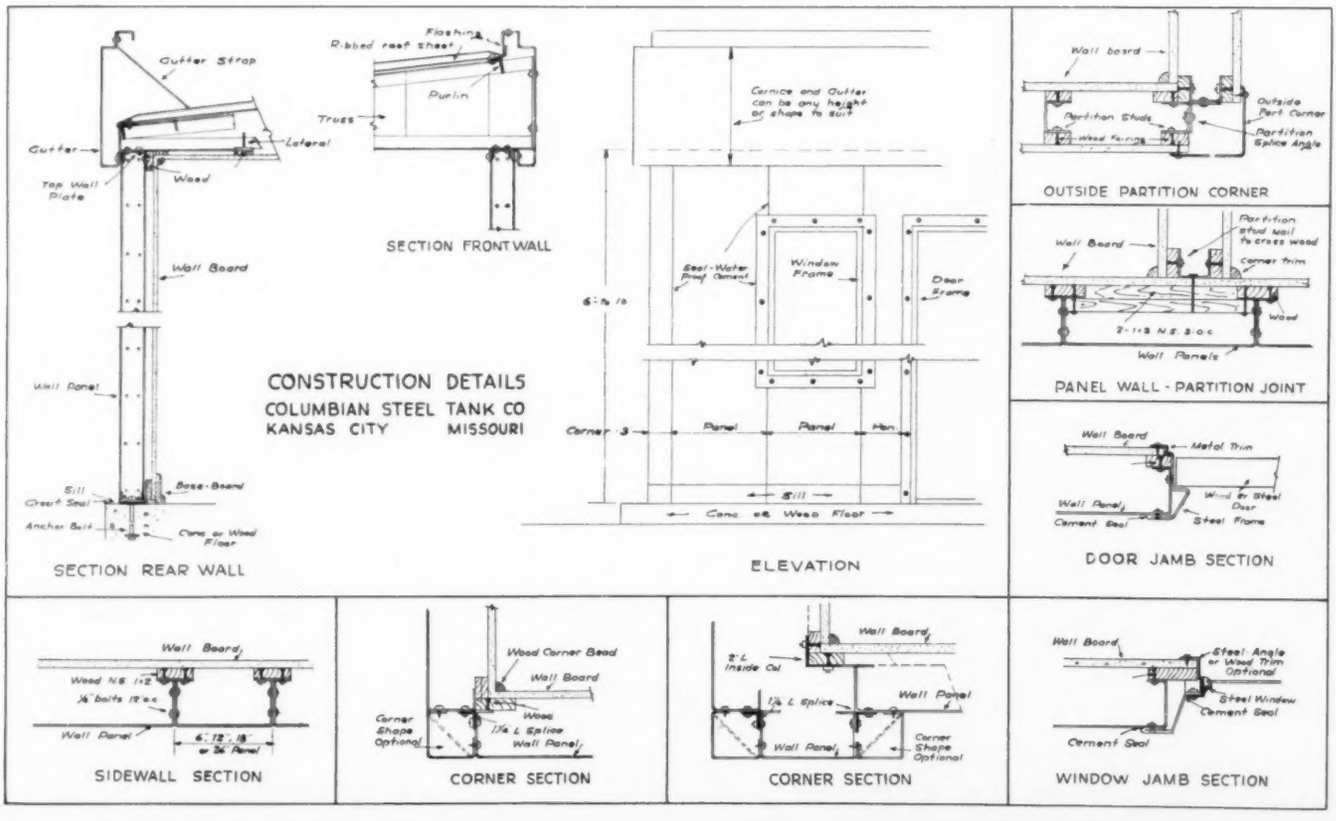
(2) Panel or Frameless Type, a recent innovation. Four sizes of simple panels made of flat sheet formed to a flanged channel, measuring 6", 12", 18" and 24" in width and 8', 9' and 10' in length. When bolted together with sealing compound in joints these panels form a flat-surfaced exterior wall. Where openings are required, panels are omitted and a window or door frame substituted. Insulation material, interior trim, roofing materials and exterior finish are optional with each purchaser. Electric wiring, fixtures and plumbing are not furnished.

This system of wall and roof construction is stated to be flexible enough to be used for practically any given building. Floor plans are not standardized, although sketches of typical residences are used to promote the use of the standardized building parts.

Prices are quoted on any custom-style house utilizing the standard construction. According to manufacturer's prospectus: "A perfectly plain building with a minimum of ornaments is of course the most reasonable in price."

$1,000 CLASS—"ORNAMENTAL IN ITS SIMPLICITY"

"HONEYMOON HOME"—BUILT OF 14 LARGE SECTIONS ASSEMBLED IN A SINGLE DAY



"WAYSIDE" MODEL
Complete with wall bed, lavatory and other conveniences, including electrical heating equipment.

"CONTENTMENT" MODEL
Price includes electric refrigerator and stove, heater, bathroom, fixtures, etc., as well as household furnishings.

These houses, completely shop-fabricated, are designed for bun galow courts, auto camps, and vacation resorts.

Prices quoted are F.O.B. Los Angeles and subject to change without notice.

All equipment necessary for household operation included in price of each model. The "Contentment" Model, according to manufacturer's announcement, offers electric refrigerator, electric stove, electric or gas water heater, solar water heater, Crane enameled sink with chromium fittings, wall bed, electric wiring, lighting fixtures, electric lighted house numbers, electric door buzzer, electric clock, Yaxley radio outlet, all plugs and switches. Metal cabinets are provided in kitchen and bathroom. Metal letter box and milk box also included. Bathroom is complete with Crane toilet, lavatory, overhead shower, and other accessories.

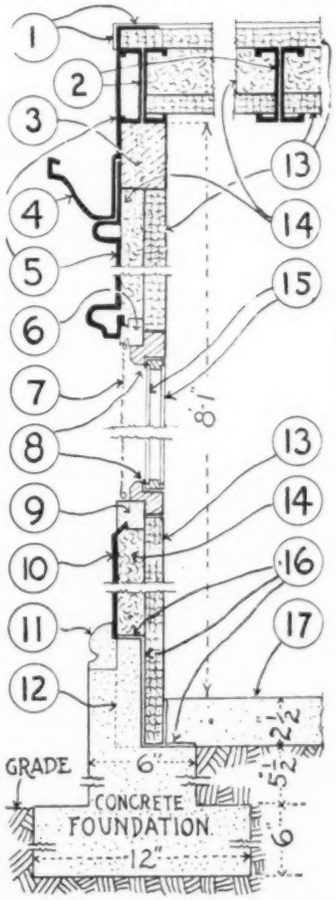
Air conditioning equipment provides heated or cooled, humidified air. Solar water-heating system has insulated storage tank.

NATIONAL STEEL HOMES
HOLLYWOOD, CALIFORNIA

Patented by HARLEY S. BRADLEY

Structural features: both house types are insulated steel construction throughout. The structural system is proof against earthquake, fire, lightning, dust, weather and dampness, vermin, pollen and noise. All joints permanently sealed. Windows consist of two sheets of glass with air space between. Gasket-lined windows and doors provide maximum protection against drafts and dampness. Copper-bearing galvanized steel is rust-resisting and unaffected by dry rot or termites. Welded or bolted construction provides maximum resistance to stresses and strains.

Entire house can be transported by truck and erected by any mechanic or carpenter.



1. Composition, water-proof roof.
2. Ceiling and roof beams of 16 gauge steel.
3. Stud bolts secures ceiling plate.
4. Conventional gutter and flashing.
5. Ornamental frieze with over-lapping connection.
6. Head jam—cross section.
7. Wire-framed screen snapped into recess.
8. Dust-proof and leak-proof window gaskets.
9. Sill plate.
10. Interlocked steel wall plates.
11. Cement water table.
12. Concrete foundations, formed with pockets to receive studding at 16" intervals, make the studding an integral part of foundations, and produce the strongest possible construction.
13. "Canec" insulation wall board, 1" thick, which covers interior surfaces, may be used as the base of any interior decoration, such as plaster, wall paper.
14. Fire-proof rock wool fills space between steel plates and insulation board.
15. Two sheets of crystal glass, set 1" apart in mastic and metal sash.
16. Waterproof membrane on inside of foundation wall plates and insulation board.
17. Reinforced concrete flooring, 2½" thick, secures insulation board on all sides.

AMERICAN HOUSES, INC.

NEW YORK CITY

HOLDEN, McLAUGHLIN AND ASSOCIATES
ARCHITECTS

This company, now entering its second year of building production, offers some 30 standard houses of prefabricated construction. Prices range from $1,975 to $15,000.

Standard equipment includes cooking, water and house heating equipment, air humidity control and circulation, electric fixtures and interior wiring, interior plumbing and complete interior and exterior decoration.

Heating: combination kitchen range, house heater, and hot-water heater, completely insulated; equipped with built-in humidifier, employing the forced air method of household heating electrically controlled.

Air conditioning: by utilizing the metal ducts to rooms installed with the standard combination house heater, for a comparatively nominal additional charge there can be added equipment for complete air conditioning which furnishes clean, cool, dehumidified air thermostatically controlled.

Foundation: concrete block, 8" wide by 4 feet deep around entire plan; 3-foot air space below first floor for additional insulation and dryness; includes pit containing ash receptacle, which rolls from position directly under range to space external to the building, making ashes readily accessible for removal.

Frame: fabricated steel on 4-foot centers; no part exposed to weather; the frame rigidly secures exterior walls and supports roof structure with a large factor of safety.

Floors: open-truss steel joists on foundation with fire-resistant composition planks, having high heat and sound resistance; finish floor of laminated cushion blocks; heat insulation equivalent to 1½ inches of cork.

Exterior walls: heat and sound insulation faced both inside and out with durable asbestos cement sheets; outside painted, inside finished with washable colored material of numerous patterns; heat insulation equivalent to a wall consisting of 16 inches of brick, with ½ inch of rigid insulation and ½ inch of plaster.

Roof: steel joists with fire-resistant composition planks covered with bonded built-up roof; 16-inch air space between roof and ceiling sections, having high heat-resistant characteristics; heat insulation through combined roof structure equivalent to 3 inches of insulating composition—in comparison, average refrigerator has 2 inches of similar heat-resistant insulation.

Windows: tested steel sash with inside screens; cranks which permit opening windows without removing screens.

Doors: white pine painted with three coats of lead and oil; hung in steel jambs.

Plumbing: copper tubing with fixtures compactly centralized with other mechanical equipment.

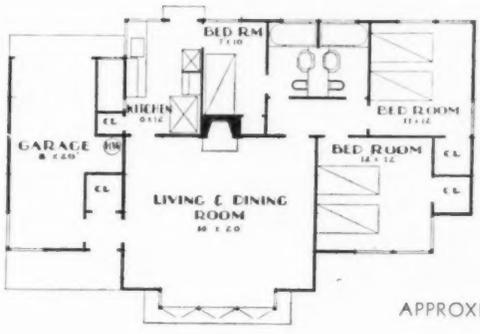
Electrical work: ceiling and base outlets in all rooms.

Interiors: ceilings painted with washable paint; ceiling height 8 feet above floor level; ceiling heights of 10 feet or higher can be furnished.

The houses can be assembled within 6 to 8 weeks, ready for immediate occupancy.

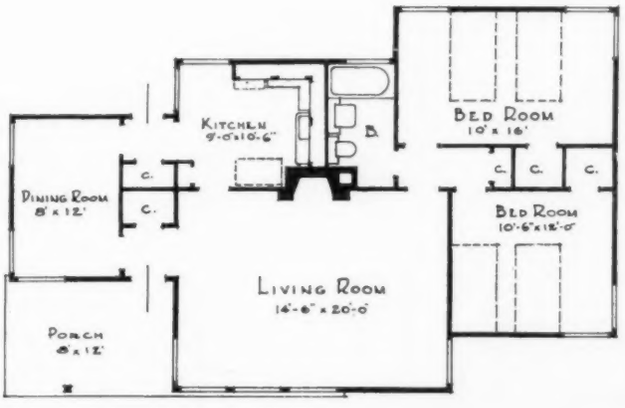
HOUSE BUILT AT CHESHIRE, CONNECTICUT
COST—$4,725, WITHOUT HEATING, COOKING, REFRIGERATION

MODEL L—5 ROOMS, 2 BATHS, PORCH, GARAGE



PLAN OF MODEL L

APPROXIMATELY $7,000



PLAN OF HOUSE BUILT AT CHESHIRE, CONNECTICUT

JANUARY—1934

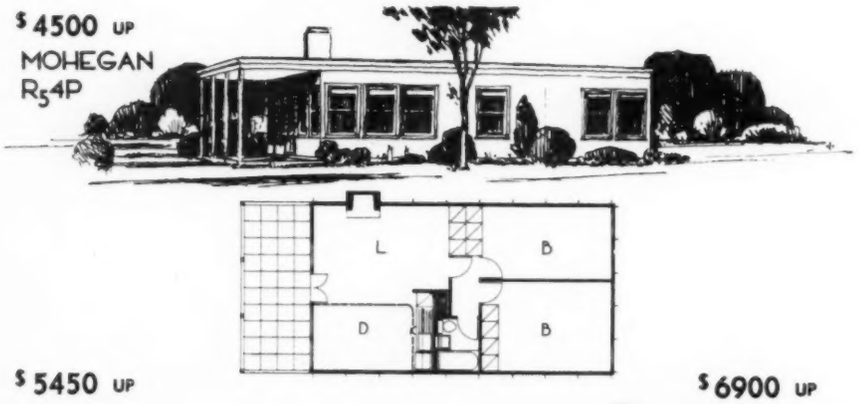
GENERAL HOUSES, INC.

CHICAGO

HOWARD T. FISHER
ARCHITECT

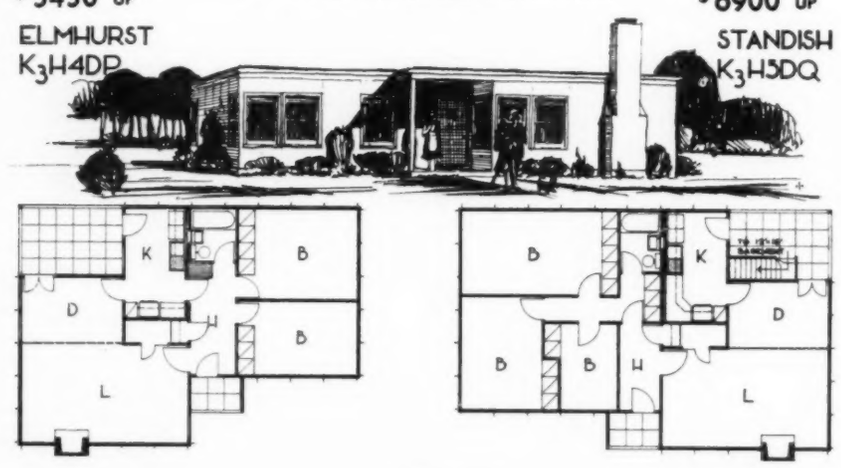
RUTH PAGE HOUSE IN WINNETKA, ILLINOIS

$4500 UP
MOHEGAN
$R_5$4P

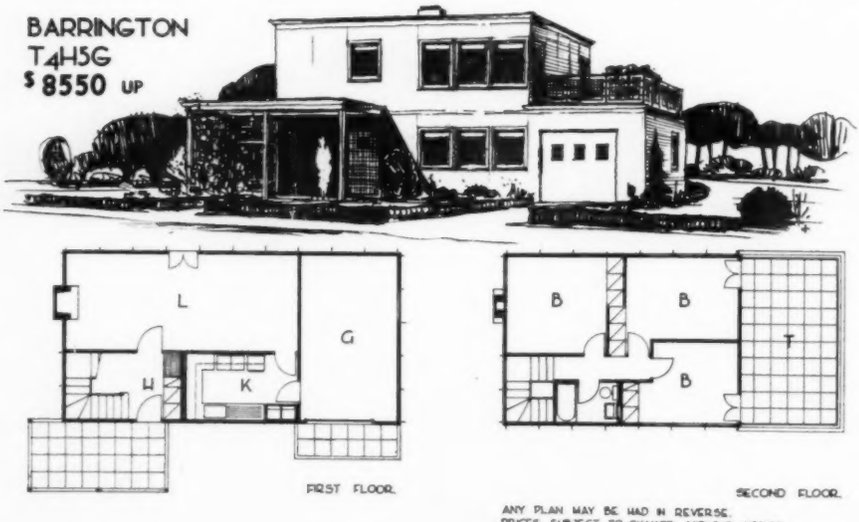


$5450 UP
ELMHURST
K_3H4DP

$6900 UP
STANDISH
K_3H5DQ



BARRINGTON
T_4H5G
$8550 UP



FIRST FLOOR.

SECOND FLOOR.

ANY PLAN MAY BE HAD IN REVERSE.
PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

This organization designs, builds and sells individual houses constructed of standardized parts. First house erected at Winnetka, Illinois, in winter of 1933 for Ruth Page.

Prices quoted on accompanying sketches are for houses completely erected on typical lot, exclusive of freight. Estimated yearly maintenance: $50 to $60 for average small house. At present units are sold direct; installment purchasing contemplated.

Standard equipment, foundations, plumbing fixtures, automatic heating, electric wiring and fixtures, screens, linoleum or wood finished floors, built-in wardrobe cases, kitchen cabinets, and porches or terraces are included in sales prices. For reasons of economy few automatic devices except thermostats are included.

Air conditioning: forced circulation of warm air, filtered and humidified. Cooling system available as extra.

Sewage disposal: connection to city sewer system or to septic tank.

Structural system: see outline specifications on opposite page.

Structural values: high degree of resistance to corrosion and physical deterioration, to moisture and atmospheric filtration, and to thermal transmission, determined by field tests. Construction largely noncombustible. Exterior painted a light shade to reflect radiant heat. Considerable sound insulation, but results inconclusive as yet.

Structural weight: approximately 3.5 pounds per cubic foot.

Houses assembled from factory-made steel panels. Approximately 600 man-hours required for house now being erected in New London, Conn. No special equipment involved in assembly. House can be occupied as soon as paint is dry.

Structural changes and alterations can be made very easily. Expected life span of houses: if properly maintained, forever. Time required for demolition: very short. Potential salvage value: very high.

OUTLINE SPECIFICATIONS

These specifications represent the current practice of GENERAL HOUSES, Inc., and are subject to change without notice.

Foundations and Basements: Concrete, reinforced as required.

Floors: Linoleum on felt on insulated steel panels (except floors on earth to be linoleum on insulated concrete slab on cinder fill).

Walls: Prefabricated panels of rust-resisting copper bearing steel alloy insulated for a heat loss of not more than 0.1 B.t.u. per hour per square foot per degree difference in temperature. Interior surface is steel, joints being covered with small panel strips.

Partitions: Faced both sides with steel and panel strips on steel studs. Partitions are insulated for sound deadening.

Roofs: Prefabricated panels similar in design, insulation, and finished surfaces to the exterior wall panel. Roof is waterproofed with built-up composition roofing.

Doors and Windows: Wood. Brass hardware. Complete weatherstripping. Windows are double hung.

Interior Trim: Wood base and picture moldings.

Fireplaces: Specially designed wood-burning unit, heating both by radiation and by convection through air passages surrounding the combustion chamber.

Terraces: Concrete on cinder fill.

Porches: Concrete floor on cinder fill. Steel posts. Steel panel roof construction as for main roof.

Trellis Entries: Steel construction with built-up composition roofing.

Roof Decks: Metal handrail and wire mesh guards. Wood slat flooring. Nautical ladder of steel provided for one-story houses.

Cases: Specially designed cases of wood for the efficient use of space, providing storage for clothing, linen, china, food, kitchen utensils, cleaning equipment, etc.

Electric Equipment: Complete wiring up to the electric meter, including fixtures and numerous outlets conveniently located.

Plumbing: Rough plumbing—all gas and water lines up to the meter location; all drainage lines to a point five feet from the building line. Finished plumbing installation is complete with chromium plated fittings, and vitreous china and enameled steel fixtures. Water heater may be either gas or oil-fired.

Air Conditioning Equipment: Gas or oil-burning automatic air conditioning system, providing heating, humidifying, and filtering of air with positive fan operated circulation. (Summer cooling may be easily added.) Oil storage tank is included with the oil-fired unit.

Screens: (for doors, windows, and porch)—Wood and bronze wire cloth.

Storm Sash: (for windows and doors)—Wood.

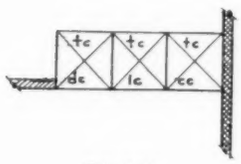
Flowerboxes: Painted metal.

Trellises: Simple design in wood.

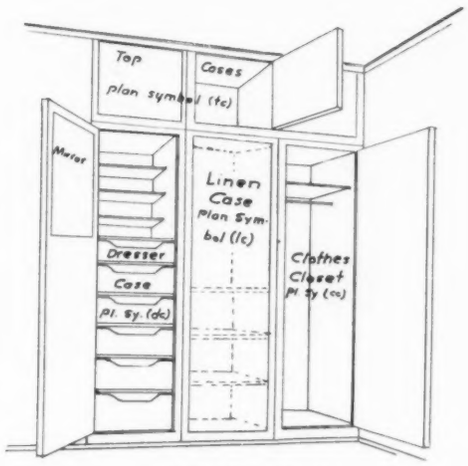
Painting: All exterior metal and wood surfaces receive three coats of paint. All interior wood and metal surfaces receive two coats of paint. Color of final coats selected by buyer from samples submitted by General Houses, Inc.

STANDARD BUILT-IN CASES

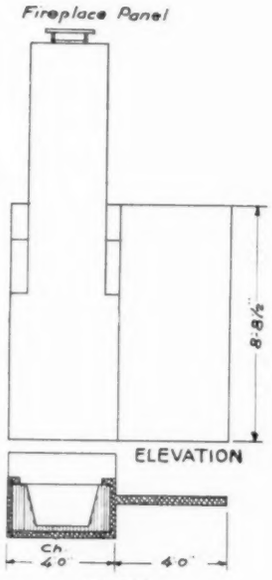
NEAT
SPACE SAVING
"A PLACE FOR EVERYTHING"



PLAN

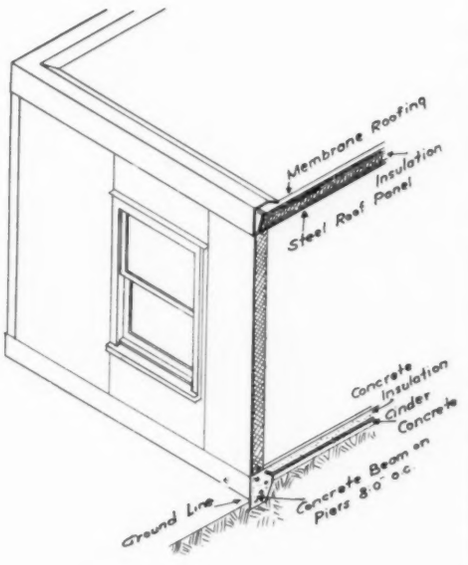


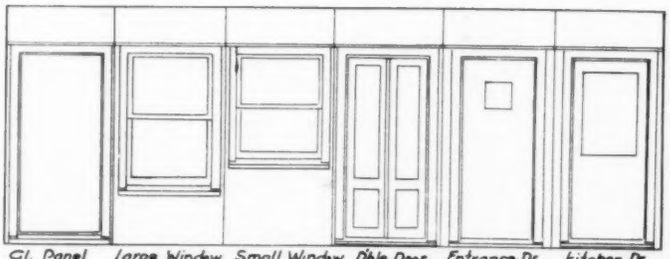
PERSPECTIVE



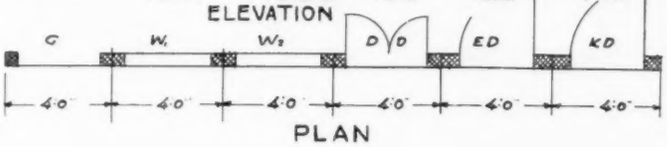
ELEVATION

PLAN





ELEVATION

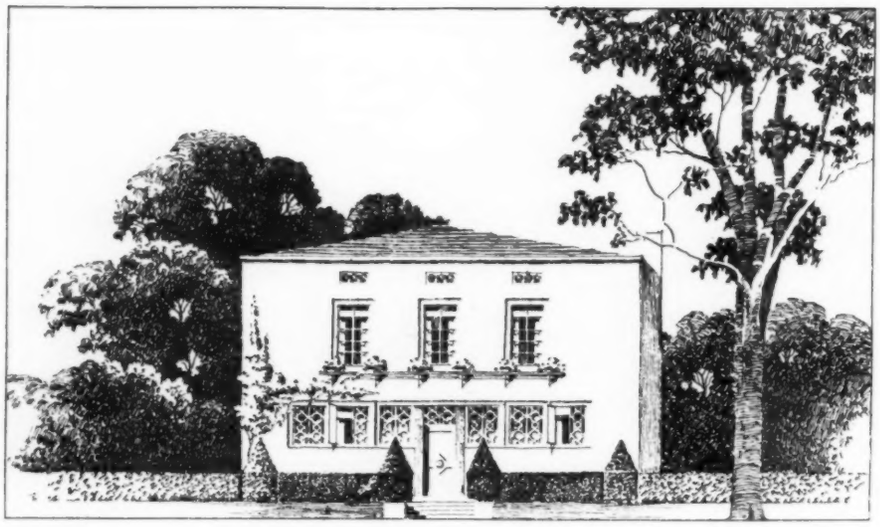


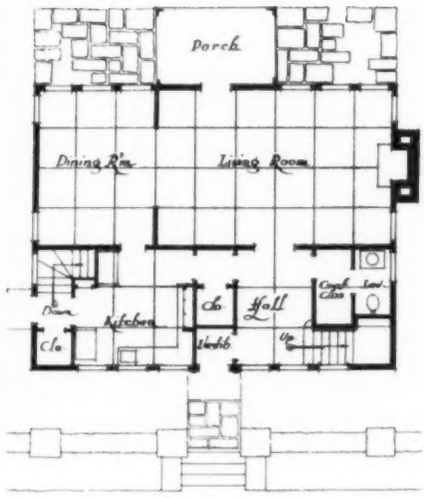
PLAN

STANDARD INTERCHANGEABLE WALL UNITS

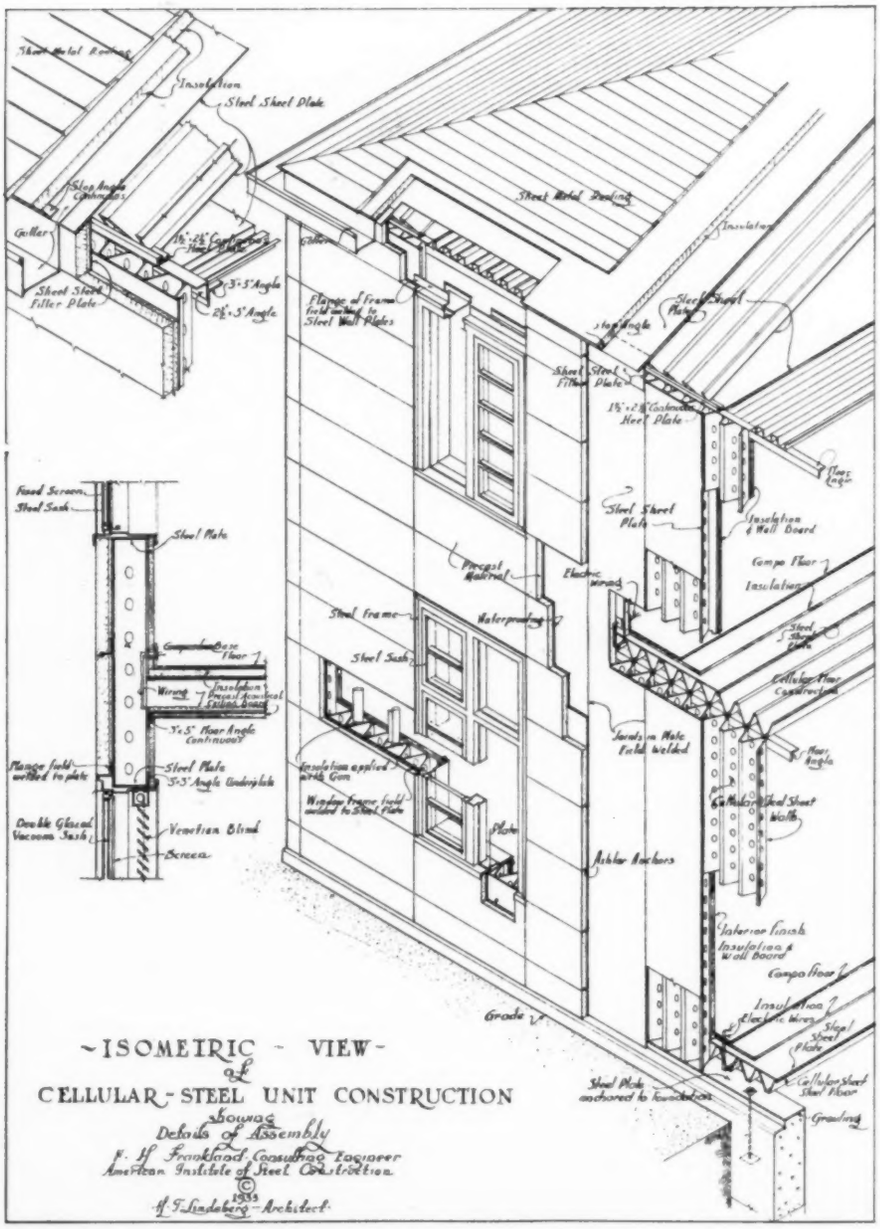
GENERAL HOUSES INC.
220 SOUTH STATE ST. - CHICAGO, ILL.

JANUARY—1934





FIRST FLOOR PLAN



~ISOMETRIC - VIEW~
of
CELLULAR-STEEL UNIT CONSTRUCTION
showing
Details of Assembly
F. H. Frankland, Consulting Engineer
American Institute of Steel Construction
© 1933
H. T. Lindeberg, Architect

CELLULAR STEEL UNIT CONSTRUCTION

HOUSE DESIGN BY H. T. LINDEBERG ARCHITECT

F. H. FRANKLAND CONSULTING ENGINEER

Principles of this housing design: (1) Economy of construction by means of mass production of units, simple construction and coordination of labor. (2) Economy and efficiency in terms of living comfort. (3) A module scheme of design deriving from the construction units; for the variety of plan and elevation possible with this scheme, see the Portfolio of House Designs by H. T. Lindeberg, published in the October 1933 issue of The Architectural Record. (4) Elimination of ornament, even the cornice.

Structural system: There is no frame; the same cellular steel unit (Robertson Keystone Beam Steel floor system) is used for walls, floor and roof. The unit is small enough to allow ample flexibility, and its lightness makes it easy to handle. Assembly is rapid, consisting solely of welding. Metal window and door frames are welded into wall structure, making permanently tight joints. Entire construction is dry above foundation walls which are of poured concrete in standard forms. Floor construction runs from wall to wall, with 2" curtain walls made of a composition of gypsum and acoustolithic plaster.

Cellular form of outer wall units permits any form of heating and acts as conduit for air conditioning, humidifying, telephone and electric wiring, and plumbing.

WHEELING STEEL HOUSE

WHEELING CORRUGATING CO.—WHEELING, W. VA.

CHARLES BACON ROWLEY and ASSOCIATES, ARCHITECTS

Built as a demonstration house in outlying residential section of Wheeling, West Virginia, to illustrate use of construction system. Completed in December, and soon to be open for inspection. Costs have not yet been determined, nor have future marketing plans been considered.

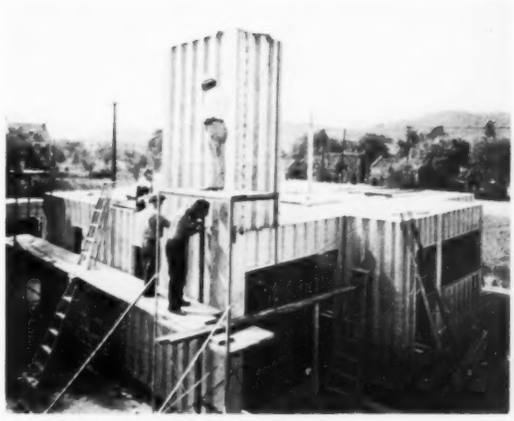
Heating system: hot water, down feed type.

Structural system: frame consists of sheet steel wall sections fabricated at factory, welded together on site and anchored to masonry foundations. Exterior walls: porcelain enamel panels, varying from 4' x 2'6" to 2' x 6" in size. Interior wall surfaces: plaster on metal lath. Floors: steel deck covered with hardwood. Roof: penthouse, composition roofing; porch, quarry tile.

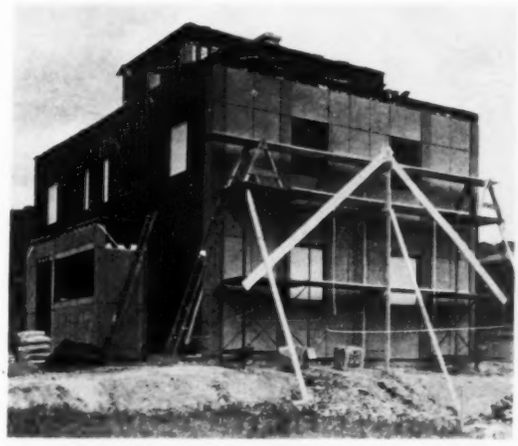
Structural values: Rock wool and insulating board give protection against heat loss equivalent to 18" brick wall. Fireproof construction. Doors are weatherstripped; filtration of atmosphere only around steel casement windows. Sound is reflected by steel and absorbed by mineral wool. Wall panels are a dark blue gray sprayed over a light gray background.

Weight: approximately one ton per 1,000 cubic feet.

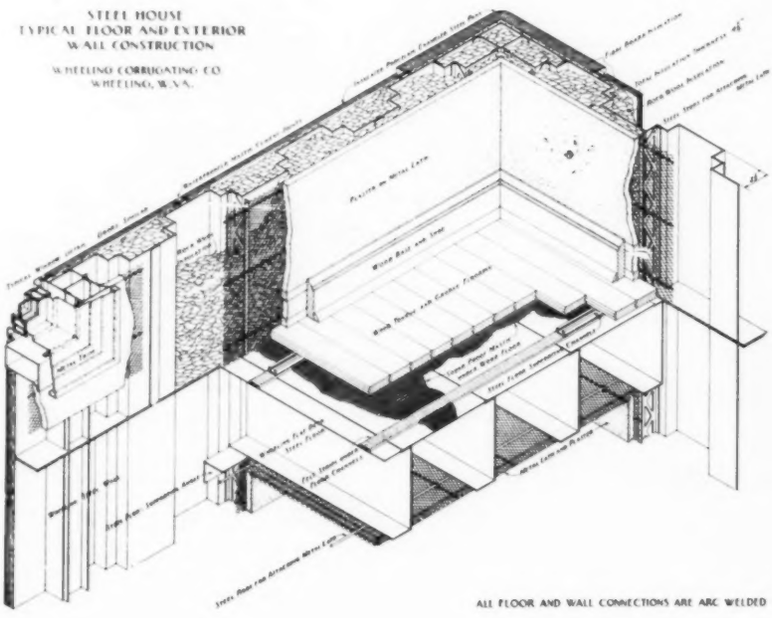
Structural system is approximately 60 per cent shop-fabricated. For erection and welding of all steel parts, including solid steel framework, 1,500 man-hours are required. House ready for occupancy about 4 weeks after assembly. Additions can made easily, but alterations are difficult. Structural longevity: same as masonry.



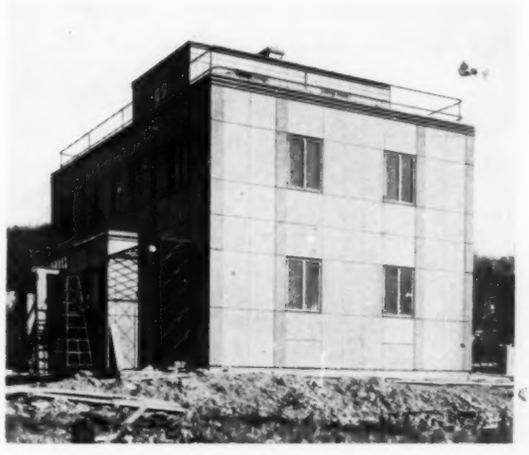
WELDING A SECOND-STORY SECTION



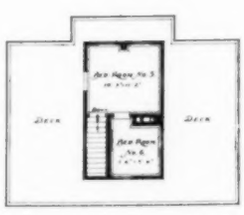
APPLYING PORCELAIN ENAMEL PANELS

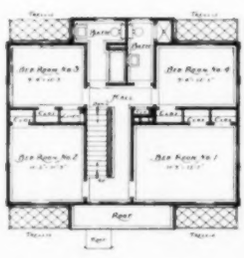


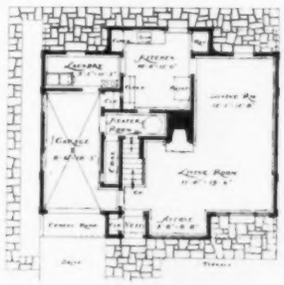
ALL FLOOR AND WALL CONNECTIONS ARE ARC WELDED



RECENT CONSTRUCTION VIEW





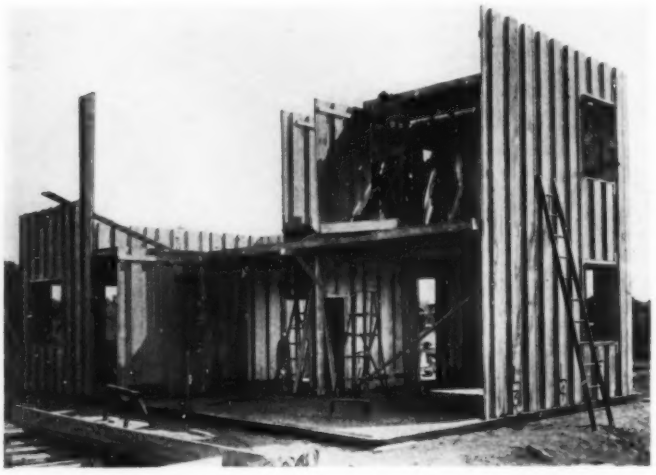


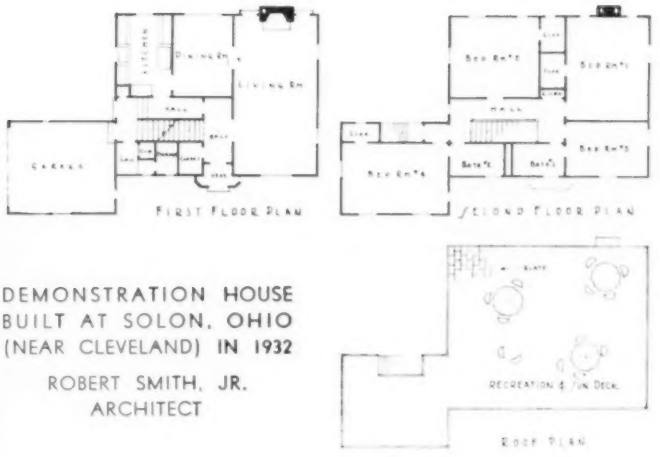
JANUARY—1934

FRAMELESS-STEEL CONSTRUCTION SYSTEM

DEVELOPED BY INSULATED STEEL CONSTRUCTION COMPANY CLEVELAND, OHIO

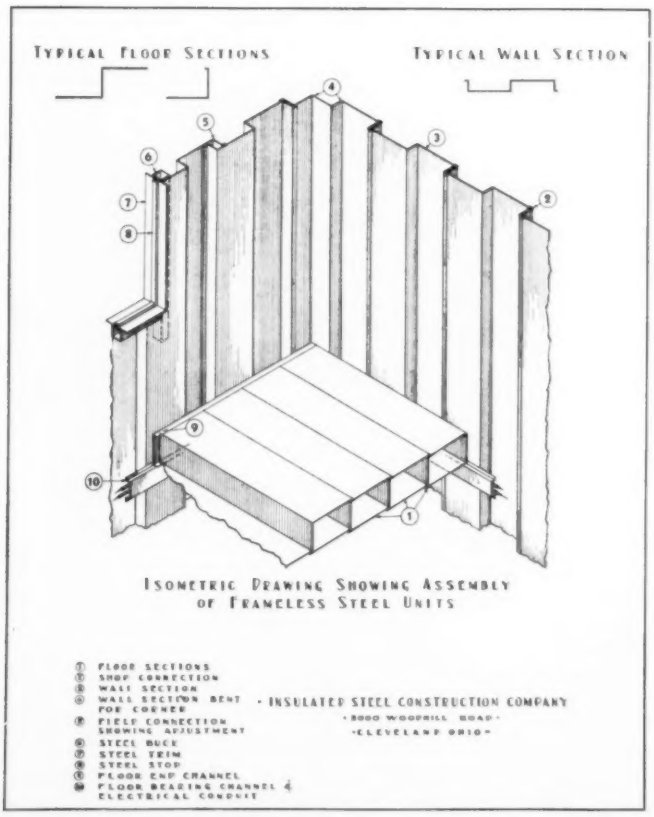
This company produces a completely-inclosed metal structural shell or "chassis" for buildings such as residences and service stations, and furnishes lightweight curtain walls, floor members and roof decking for larger structures.





DEMONSTRATION HOUSE
BUILT AT SOLON, OHIO
(NEAR CLEVELAND) IN 1932

ROBERT SMITH, JR.
ARCHITECT



This product is called "Frameless-Steel" because no framing members are required in residences and other small structures.

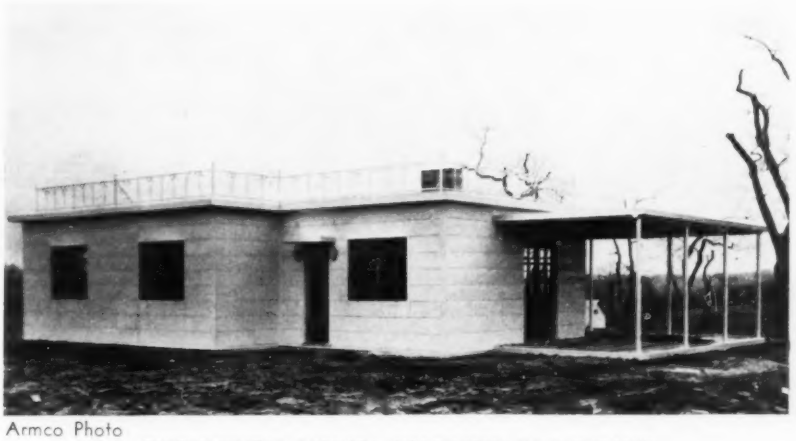
Strength and rigidity are attained in the forming of light steel sheets. When sections are assembled into the "chassis," a continuous nailing surface is provided. The "chassis" replaces, in conventional frame construction, the joists, studs, rafters, bracing, sheathing, window and door frames, and interior and exterior trim. Window frames, door frames and electrical conduit are installed in the wall units complete before delivery to the job.

Z-shaped floor sections are lapped and boxed in at ends with an L-shaped member, providing both subfloor and subceiling. Depth of floor web: 5½". Web spacing ordinarily 8" on centers but can be varied for unusual loads. Dimensional adjustments of both wall and floor sections can be made by telescoping, thus eliminating field cutting.

In shop assembly, an electric spot welder puts weld in top and bottom of sections simultaneously to form large erection units. Welds in floor sections are 5½" apart. Field fastening of erection units is simply made with sheet metal screws. All standard building materials may be attached directly to the steel with screw-threaded nails.

Structural values: strong and rigid, yet light in weight. Storm and lightning safe. Vermin-proof, not subject to attack of termites. High insulation values (both heat and sound). Time of field erection materially reduced. Complete salvage value for "chassis."

COST: $2,770



Armco Photo

EXPERIMENTAL HOUSE—COMPLETED IN DECEMBER

UNIVERSAL HOUSE CORPORATION

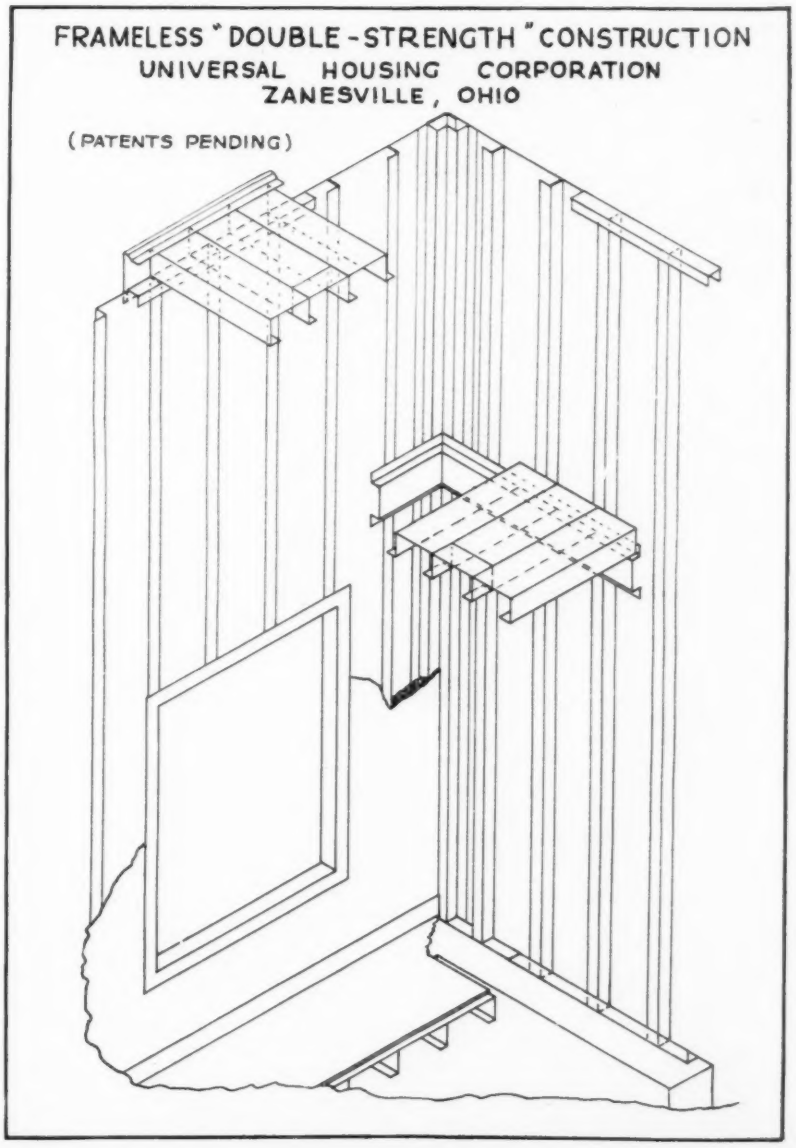
ZANESVILLE, OHIO

This company has announced its intention to produce houses for low-income families. An experimental house containing living room, three bedrooms, bath, dinette-kitchenette and a large porch has been recently completed.

The house plan can be duplicated for $2,770 in central Ohio, but the company's policy is to erect individually-planned custom-built homes in a higher price range. Edward L. Garrett, president, reasons that rural and suburban development will be the volume market for factory-made field-assembled houses. Work is under way on development of smaller low-priced units suitable for suburban locations and designed in several floor plans.

Structural system: Exterior siding is 16-gauge ingot iron formed in trough-shaped sections to give rigidity and load-carrying ability. (Although first house was built with tubular frame, a frameless system has now been developed.) Wall units were bolted to frame and then bolted together through flanges. Exterior sprayed with enamel paint. Floors and roof also of Armco sheet steel wide-flanged units; assembled on job but hereafter to be factory-assembled in large convenient sections. Steel window sash, frames and bucks. Pine doors and trim. Gypsum board used as subfloor with hardwood finish for all floors except bath where mosaic tile is installed. Roof: built-up asphaltic type put down over ½" insulating board.

Structural values: Insulated with ½" Insulite wall board decorated with Walltex as interior wall finish; space between wall board and metal wall filled with spun glass insulation. House is fire-resistant, lightning-safe, will not shrink and is vermin-proof. Field erection simple and easy. Maintenance cost should be low.



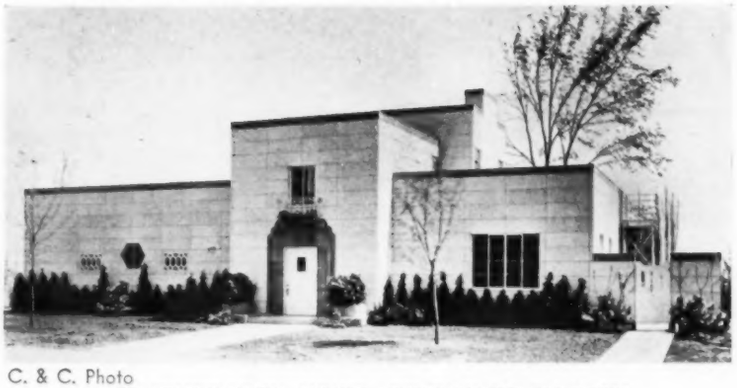
ROSTONE HOUSES

WALTER SCHOLER, ARCHITECT

These are not factory-fabricated houses but a demonstration of a new structural system making use of materials which are very largely shop-fabricated, requiring a smaller proportionate field erection cost.

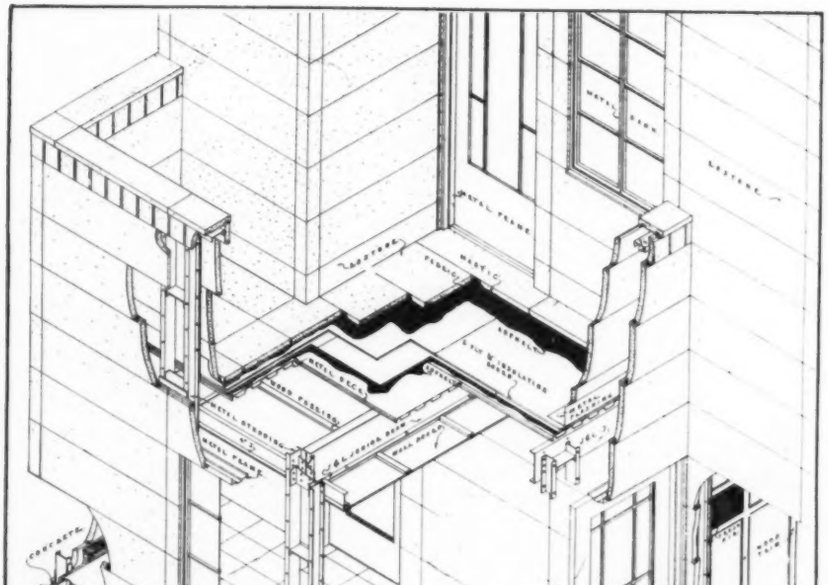
Primary material: A new stone-like substance called "Rostone," a synthetic product composed of shale, alkaline earths and limestone quarry waste. The material has a wide range of colors and color treatment. It is produced in slabs, panels and other forms to precise dimensions.

Structural system: Structural steel framework on concrete foundation. Vertical steel members are spaced uniformly 4 feet apart, a module which corresponds with length of Rostone slabs. These slabs are 18" in height and 2" thick, with ship-lap joints in mastic, and are bolted to the steel studs with a cushioning layer of insulating board. Bolts engage in threaded metal thimbles cast with Rostone slabs. Application of interior finish to steel framework depends on material used. Flat roofs are steel decks supported on steel beams over which is a thick layer of light-density Cornell insulating board on which are placed Rostone roof slabs.

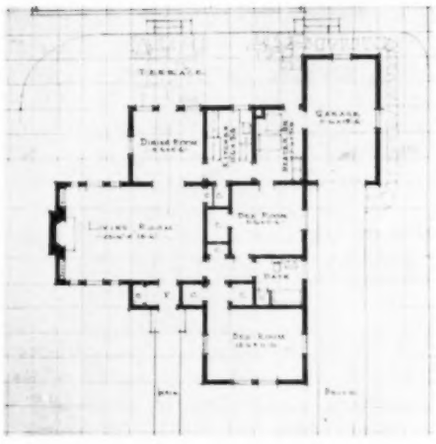


C. & C. Photo
DEMONSTRATION HOUSE—CENTURY OF PROGRESS

J. G. Allen



ROSTONE, INC.
LAFAYETTE, INDIANA



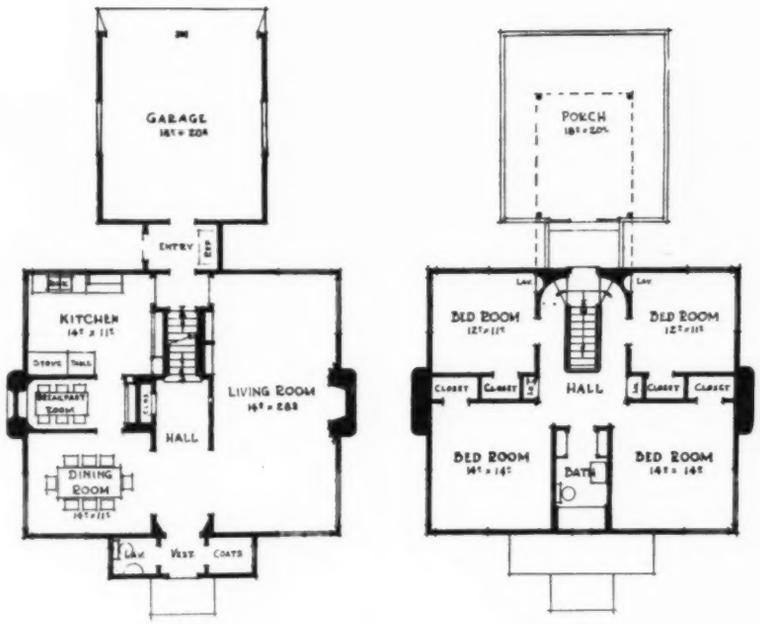
COLONIAL COTTAGE
WEST LAFAYETTE, IND.

The strength, permanence, weathering quality, moisture-resistance and other physical properties are exceptional, and have been demonstrated through 5 to 8 years of severe exposure as well as through laboratory tests, according to report.

In the Century of Progress house Rostone is the only facing material. It is also used for (1) roof slabs, (2) interior flooring, (3) interior wall treatment, (4) fireplace as well as various other minor details.

FERRO-ENAMEL HOUSE

CHARLES BACON ROWLEY & ASSOCIATES — ARCHITECTS



House constructed July 1932 in Cleveland. Occupancy: one family, 4 persons.

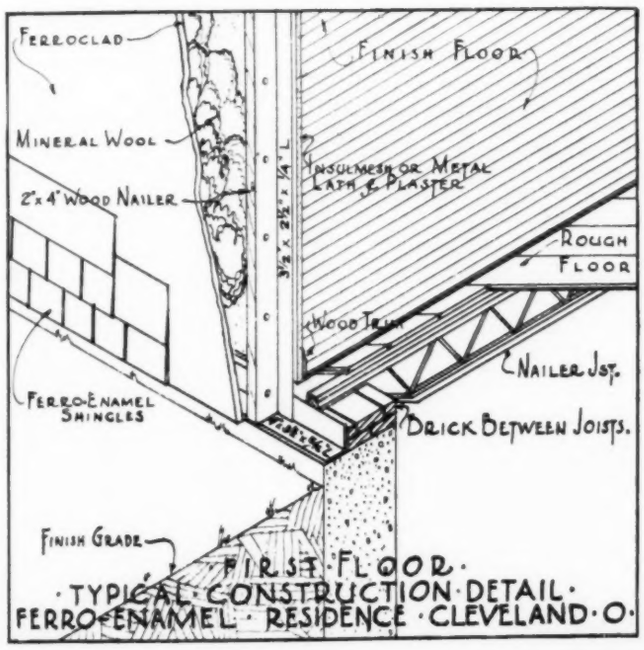
Approximate cost: $14,000 without land. Maintenance: $40 annually for painting metal windows, frames and doors.

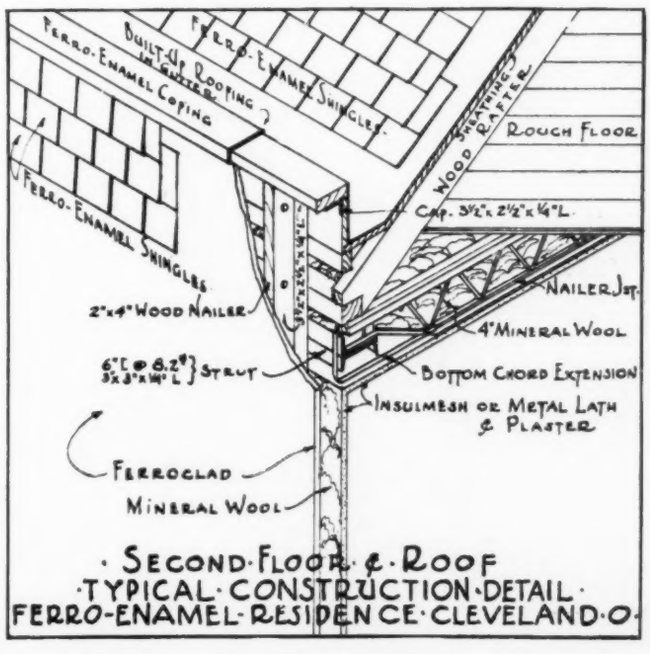
Heating system: forced warm air, filtered, automatically humidified. Electric illumination. Dish-washer sink.

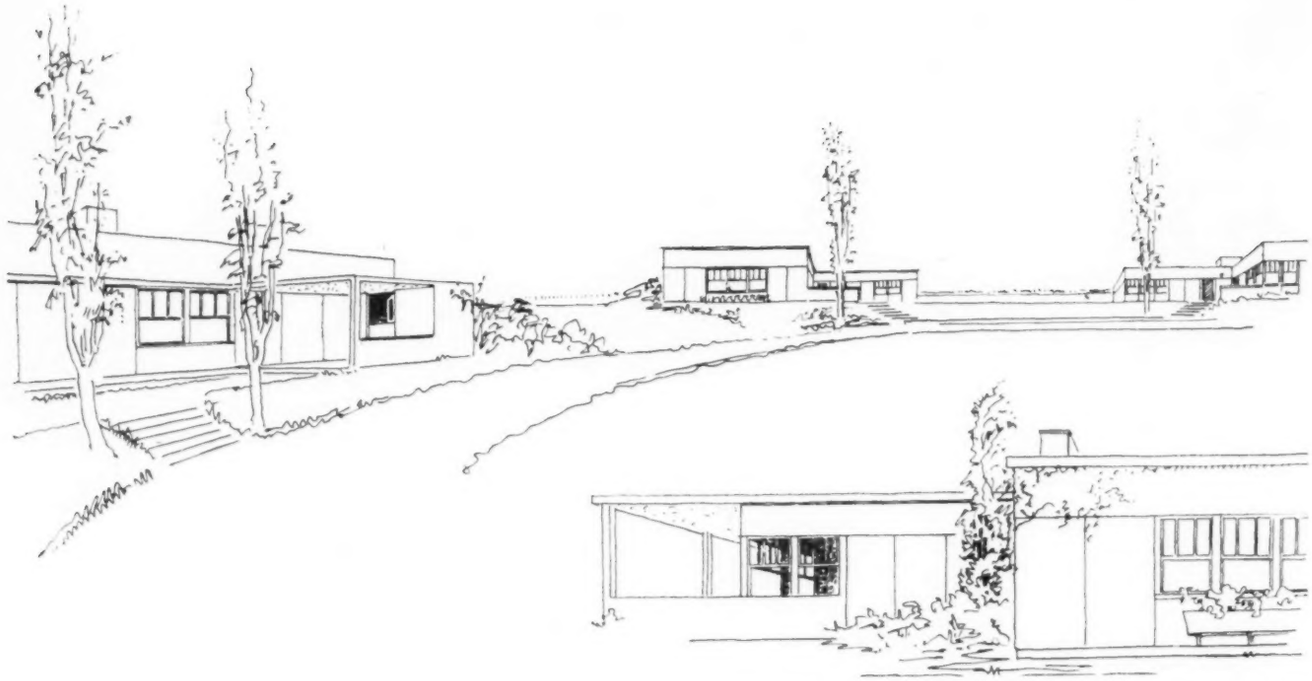
Construction: Thermal transmission same as 24-inch brick wall. Light reflected by porcelain enamel finish. Sound absorbed by mineral wool. Weight: approximately 1 ton per 1,600 cubic feet.

Structural system entirely shop-fabricated except for assembly. Electrically welded at site. House ready for occupancy 2 to 3 months after frame assembly. Structural changes not easily made, but repairs are not likely to be necessary. Expected life span: same as masonry.

This house was built to demonstrate use of porcelain enamel shingles as exterior building material. Since then the shingles have been used as roofing for several buildings.







NEGRO HOUSING

PROPOSED FOR RICHMOND, VIRGINIA

ALFRED KASTNER ARCHITECT

Proposed housing is combined with subsistence farming for Negro workers.

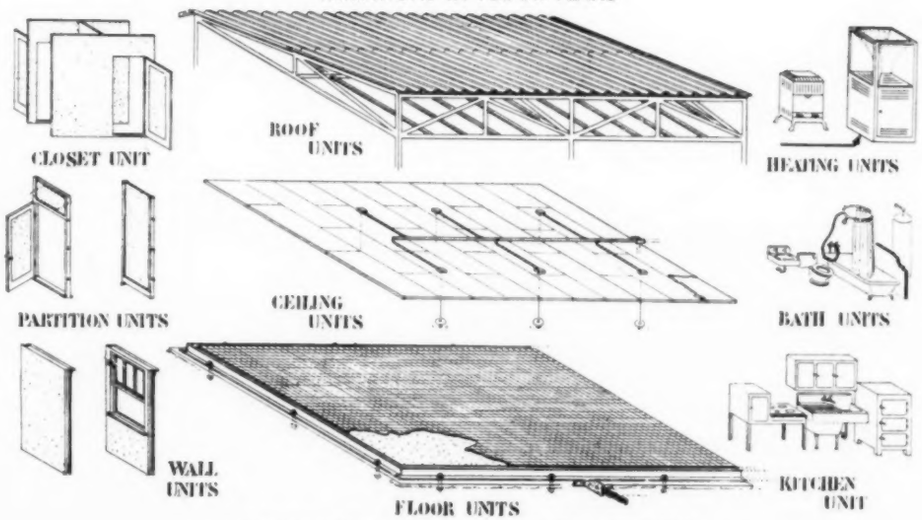
Financing is to be done through a cooperative organization of 500 prospective owners who contribute one-third equity, chiefly in the labor. On the basis of this equity a loan sufficient to cover the remainder of the investment is contemplated from a Government loan institution.

Estimated cost of each housing unit: $1,000. Each unit will occupy a half acre, costing $150 on a large-scale cooperative purchase. An additional $150 for each unit is estimated as cost of improvements such as streets and utilities. (Further details as to this method of financing and organization are to be found on pages 165 to 168 in the March 1933 issue of The Architectural Record.)

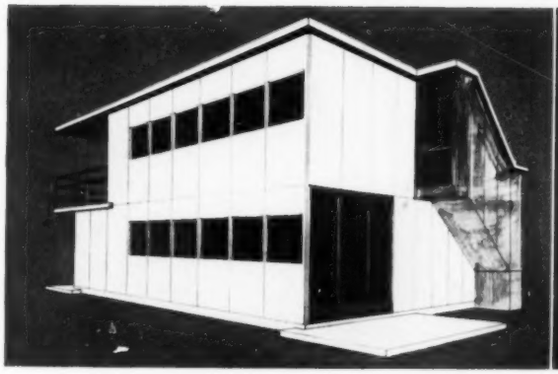
Utilities: oil heater, bath unit, kitchen unit. Illumination by electricity.

Structural system: prefabricated units of reinforced concrete to be erected by unskilled labor of the house occupants. Interior partitions permit various arrangements.

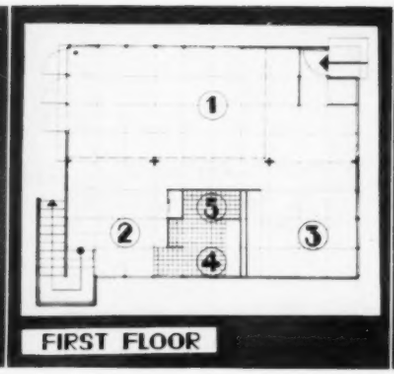
VARIATIONS IN FLOOR PLANS



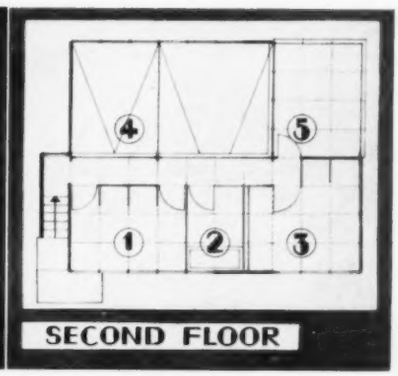
STANDARDIZED UNITS FOR HOUSE ASSEMBLY



TYPE "A"—$4,000



(1) Living room, (2) dining room, (3) library, (4) kitchen, (5) heater.

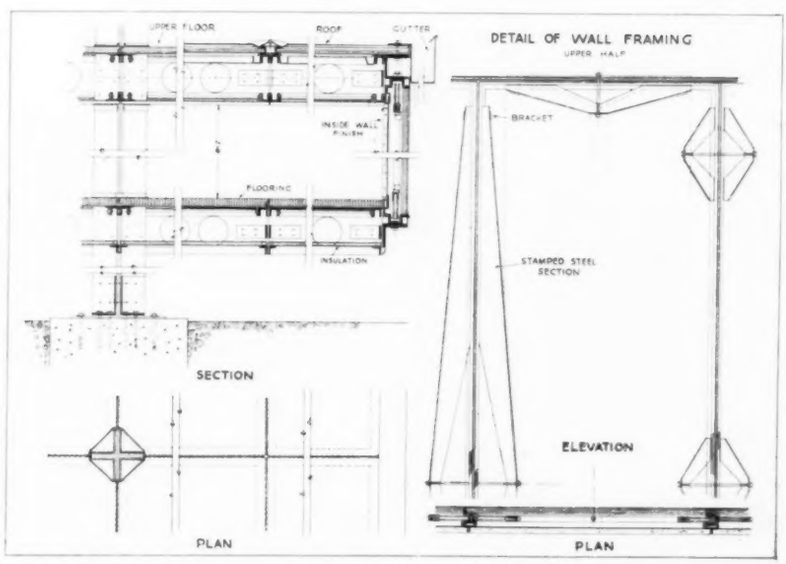


(1) Children's bedrooms, (2) bathroom, (3) bedroom, (4) upper part of living room, (5) roof terrace.

TWO HOUSES FOR QUANTITY PRODUCTION

WALTER BAERMANN, DESIGNER
HOLYOKE, MASSACHUSETTS

TYPE "B"—$1,200



Intended for low-income families: (A) 5 to 8 occupants, (B) 6 occupants.

Estimated cost of single houses: (A) $4,000, (B) $1,200, including financing but not land. Cost per 100 units: (A) $3,000 or less, (B) $850 to $900. Units to be sold direct. Annual heating expense: (A) $90, (B) $60.

Utilities: oil burner, hot-water heating. Septic tank for sewage disposal. Electric lighting.

Interior equipment: simplified kitchen layout. Plumbing closet. Murphy beds. Folding partitions.

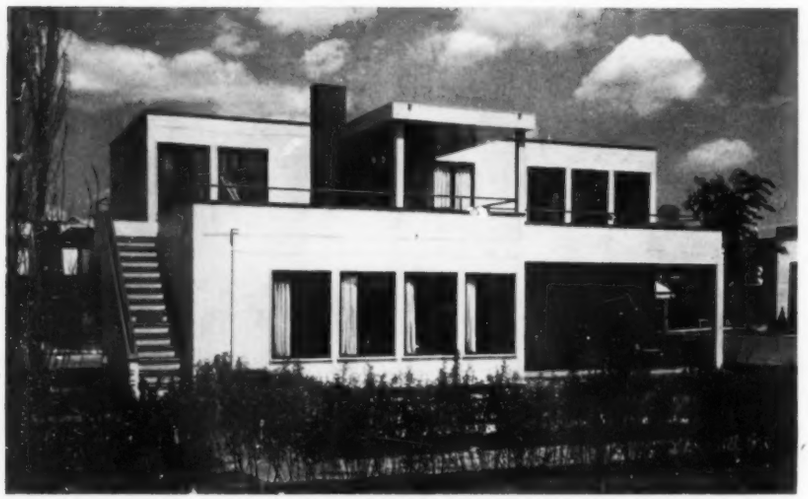
Materials for exterior and interior surfaces selected as desired, painted in colors according to direction of sunlight.

Structural system: fireproof, insulated. Completely shop-fabricated. All parts light enough to be handled by one or two men with ordinary tools; no part heavier than 150 pounds. Time required for assembly on site: (A) 48 hours; (B) 36 hours. For demolition: 7 hours. Materials salvageable.

Complete dry construction with exception of point foundations. Four or more center columns, each composed of 4 L-shaped sections. Stamped steel-beams, ¼-inch thick and about 12 inches high, interlock with clips to fasten floor and ceiling units.

Walls in 3-foot sections. Frames are tension members counterbalancing floor and ceiling construction. Windows integral with these sections. Connections by means of tie rods and springs with rubber cushions like Frigidaire wall sections.

Provisions made for electric panel heating. All wiring may be in the panels.



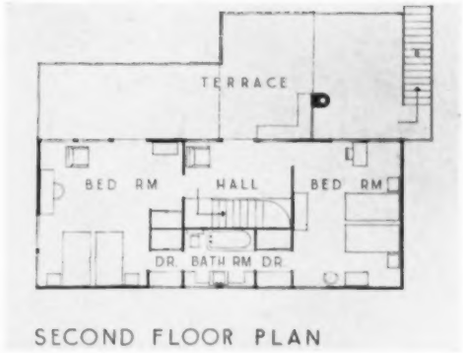
DESIGN FOR LIVING

JOHN C. B. MOORE, ARCHITECT

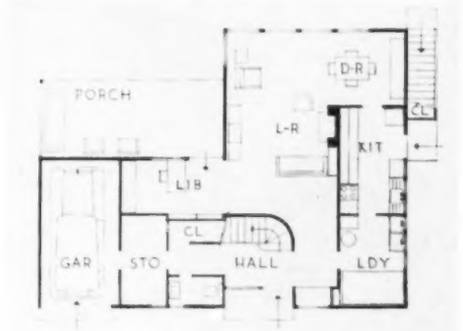
C. CLEMENTS HORSLEY
AND RICHARD C. WOOD
ASSOCIATE ARCHITECTS
INTERIORS BY GILBERT ROHDE

CONSTRUCTED FOR
A CENTURY OF PROGRESS
CHICAGO EXPOSITION
1933

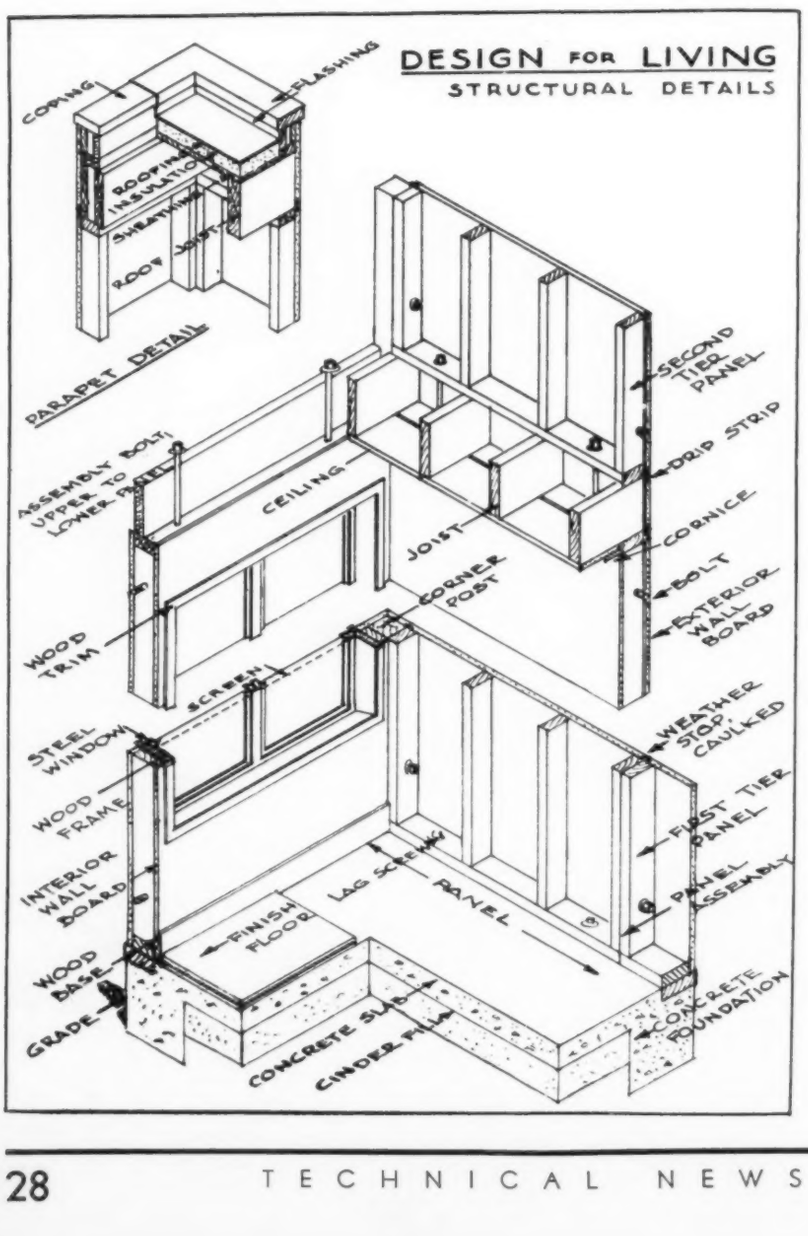
Designed for maximum space with minimum area



SECOND FLOOR PLAN



FIRST FLOOR PLAN



Frame construction put together in panels selected as cheapest, easiest to erect and simplest to adjust.

Cost: approximately $8,000 in a metropolitan area, fully equipped as described, but exclusive of financing and land costs.

Air conditioning: Holland hot air furnace; water spray humidification, filter; electric fan circulation.

Electric light, direct illumination.

Built-in Kitchen Maid cabinets, and cases of drawers in dressing rooms and bathroom. Other built-in furniture proves inflexible and expensive. Overhead garage door.

Exterior wall surface: Thermasote. Interior wall surface: Gypsolite wall board. Linoleum for ground floor; asphalt tile on kitchen and baths. Carpet over rough plywood flooring on second floor. Roofing: built-in tar and felt.

Structural value: same as normal frame construction. Roof surfaced with aluminum paint to reflect and reduce penetration of heat rays of the sun. All interior ceilings have ¾" Insulite for sound absorption and insulation.

Weight: approximately 3.19 pounds per cubic foot.

All exterior wall panels shop-fabricated and fastened with simple bolts and lag-screws. Approximately 64 hours required for assembly of structural frame; 3 weeks additional before house is ready for occupancy. One week required for structural demolition, including foundations. Expected life span: indefinite, as in case of a well-built frame house.

Potential salvage value: all exterior wall panels, built-in doors and window frames, floor and roof timbers, stairs, equipment and accessories.

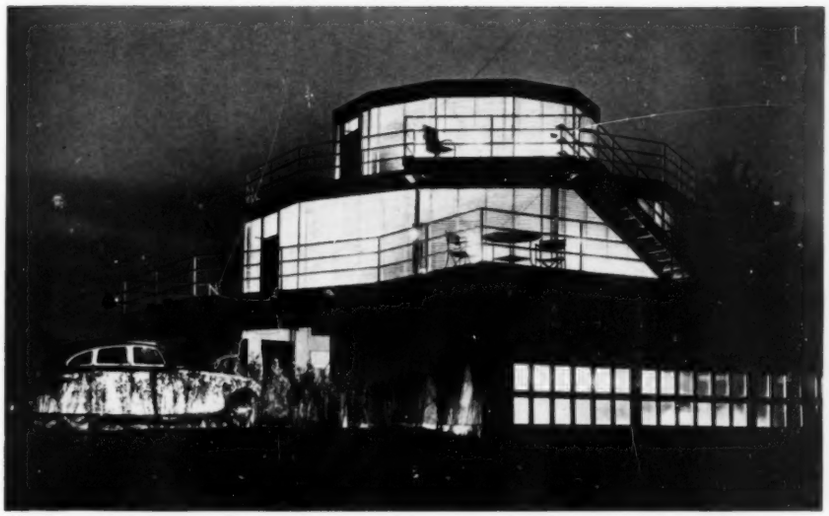
HOUSE OF TOMORROW

CENTURY HOMES, INC.

CHICAGO

GEORGE FRED KECK

ARCHITECT



Kaufmann-Fabry

EXHIBITION HOUSE—CENTURY OF PROGRESS EXPOSITION

Designed to demonstrate mechanical equipment and new materials now on the market. Not intended for quantity production as designed, but possible to do so if slightly altered. At present no estimated cost. Cost of demonstration house: between $20,000 and $25,000. Estimated yearly maintenance: $500.

Air conditioning: heating, cooling, humidification with humidistat control; air washer; fan and blower. No movable windows in house.

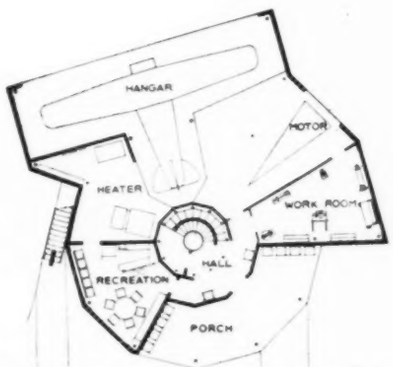
Structural system: concrete foundation and floor slabs. All other construction is "dry"; no plaster. Structural steel frame, entirely shop-fabricated and bolted together on site. No bearing walls. Phenoloid board for exterior and plaster board for interior on first floor. Store front plate glass exterior; glass sizes determined duodecagonal floo. plan. Floors: U. S. Gypsum "Red Top" Steel, joist construction. Interior partitions: synthetic wall boards covered with glass, wood and lacquers. Interior partitions between garage and workroom: insulation board covered with bright aluminum foil to reflect heat. Roof: waterproof compressed asphalt board.

Structural values: earthquake resistant because of cantilever frame construction. Questionable whether glass walls will withstand tornados. Vermin-proof since all construction is above ground.

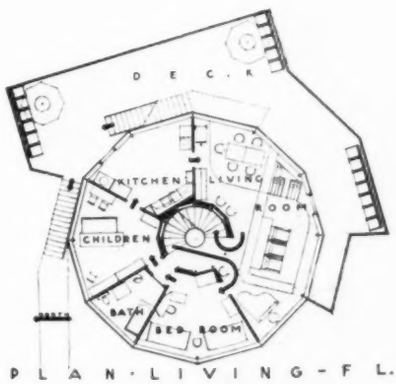
Thermal transmission: while house was being heated during November, it was found that large glass surfaces did not increase heating load although outside temperatures dropped as low as 20°. Infiltration is reduced because windows are fixed. A recirculation duct, ¾" wide, along inside perimeter of house collects cool air at bottom of windows.

Illumination: outside daylight obtained through large glass areas and intensity controlled by means of opaque roller screen, venetian blinds and drapes. Electric lighting in living room and conservatory also controllable to desired intensities by means of dimmers.

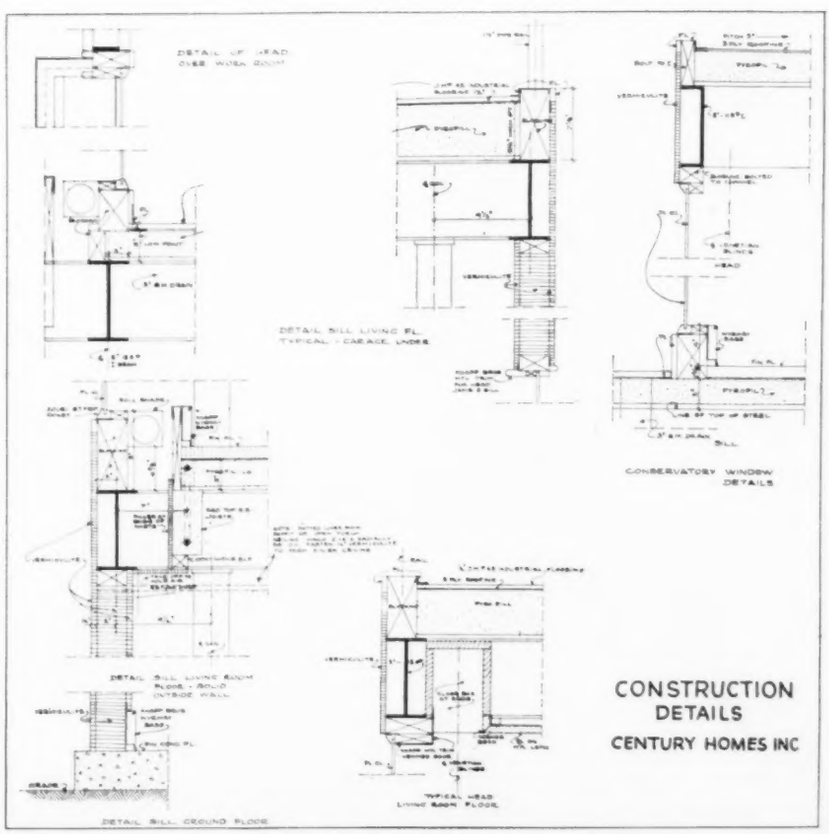
Assembly: 48 man-hours required on site for frame assembly. Entire house can be built in 30-60 days. Time required for demolition: one week. Expected life span: 50 years.



PLAN · GROUND-FL.



PLAN · LIVING-FL.



JANUARY—1934

LOW-COST FARMHOUSE

A. LAWRENCE KOCHER and ALBERT FREY

Palmer Shannon

MODEL OF FARMHOUSE "B"

The rooms of this house have been planned in a use-relationship to farm life and work, based on a listing of requirements supplied by a committee of sociologists specializing in farm activity. Occupancy: 2 adults, 3 children.

Cost: $1,750, not including land and financing. If produced in quantity, $1,200 to $1,500. Small upkeep because no deterioration from dry rot.

Built-in furniture and equipment: china cupboards, kitchen table, cabinets, bed closets, clothes and linen closets, storage racks.

Heating: hot-air furnace, with filter. Ample ventilation through windows; roof terrace provides space for outdoor sleeping.

Utilities: electric lighting. Septic tank sewage disposal.

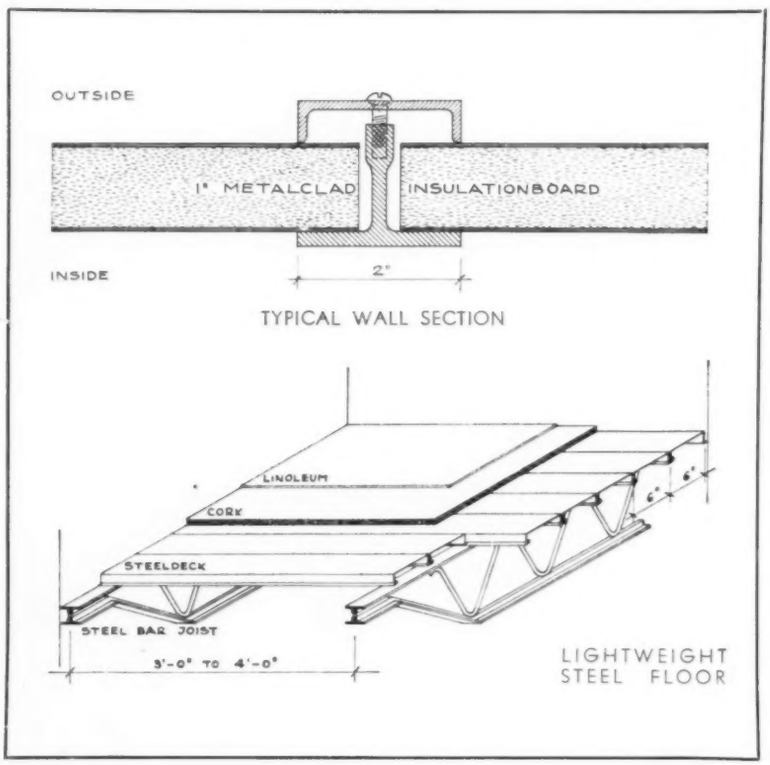
Structural system: Rolled steel frame. Painted sheet-steel surfaces, interior and exterior. Steel deck floors with insulation board and linoleum finish. Steel deck roof with insulation board and built-up roofing. All building parts now obtainable from industries in the open market.

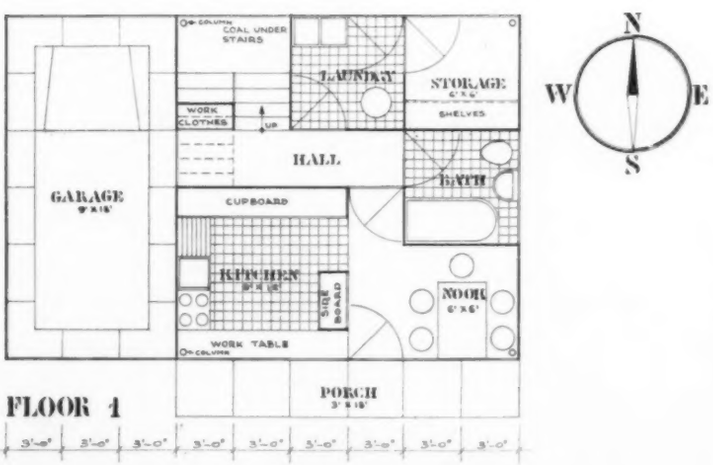
Structural values: completely fireproof; earthquake and tornado proof; not affected by termites or vermin; protected against corrosion. Windows are tight-fitting and can be double-glazed. Superior to average masonry wall in insulation value. Ample sound absorption at ceiling.

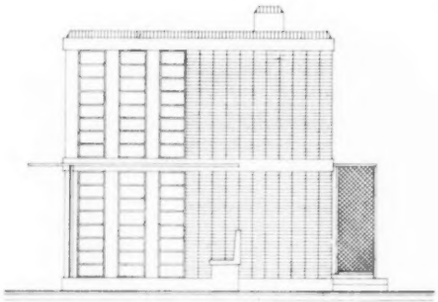
Weight: approximately 1/10 of masonry house.

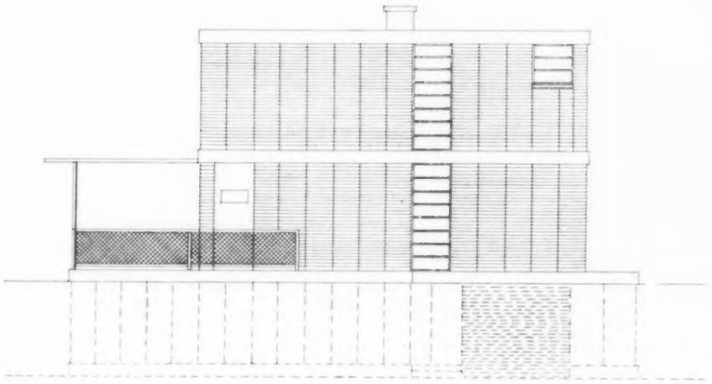
Construction shop-fabricated; no cutting on job; only assembly of parts. Time required for erection—200 man-hours. House immediately ready for occupancy. Structural system suited to enlargement or replacement of parts.

Expected life span of structure: house can be used a full generation. Demolition: 12 hours. Full salvage value.

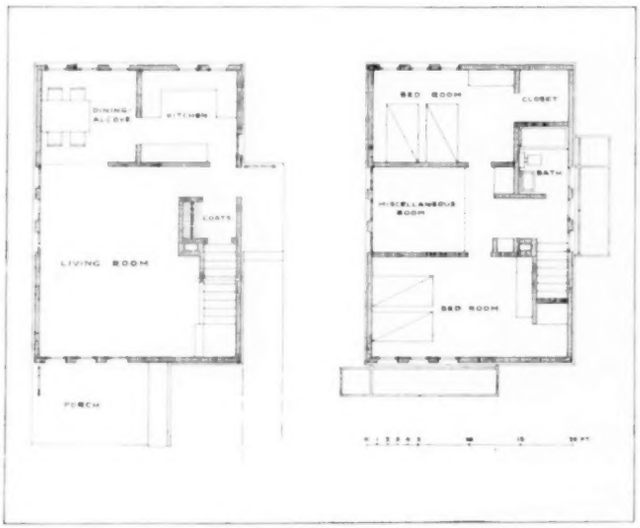








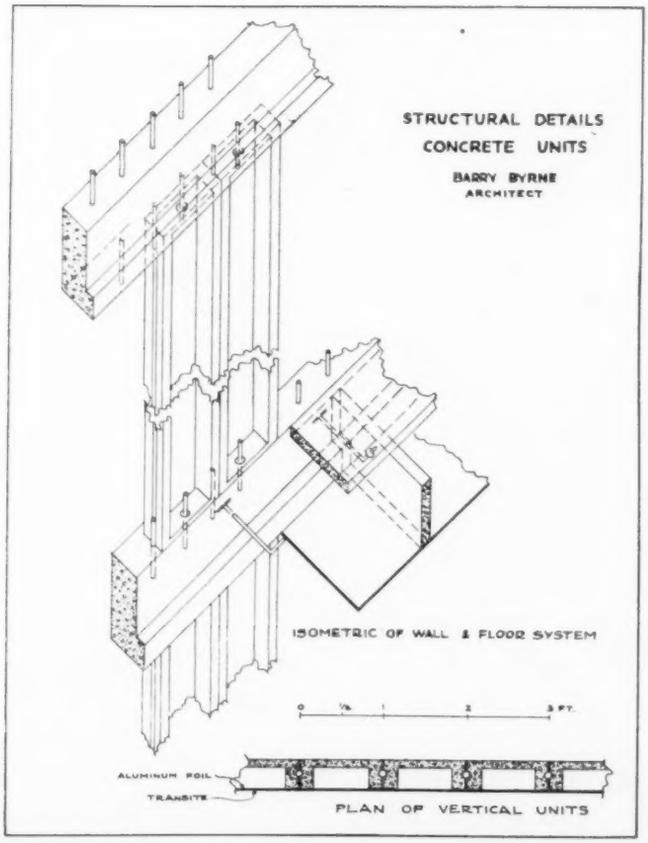
(Above): Elevation of plans shown below.
(Right): Side elevation of another house type which could be 3 stories high.



CONCRETE UNIT SYSTEM

BARRY BYRNE, ARCHITECT

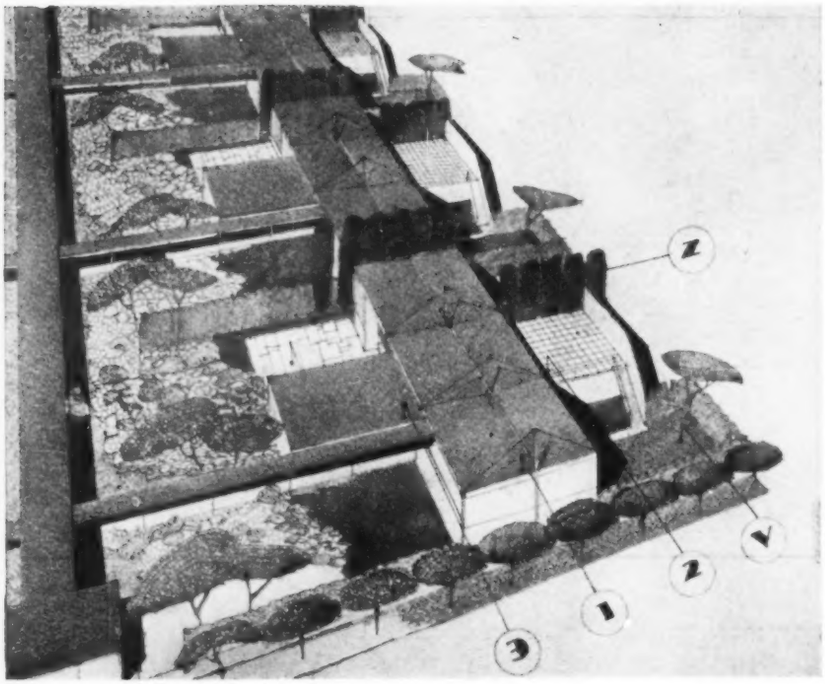
This scheme was devised to provide a relatively dry construction, with units adaptable to varied plans, exterior masses and proportions of parts. Aside from foundations, it is shop-fabricated and field-assembled.



House design planned for 2 adults, 3 children.

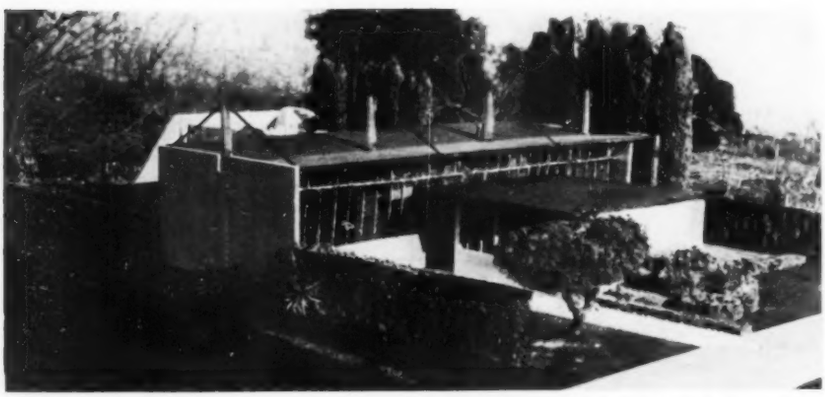
Air conditioning furnace; air circulation by means of blower in hot weather. Connection to municipal sewage system assumed. Illumination: concealed lights at junction of walls and ceiling with rays directed downward on wall at points to accent wall surfaces as related to plan. Kitchen equipment and garbage incinerator built in.

Structural system: pre-cast concrete units for structural frame and exterior walls. Interior wall surfaces finished in duPont wall fabrics. Floors of cork over cement. Prepared roof, cork insulation. Construction fireproof, resistant to vermin, physical deterioration, thermal and atmospheric transmission.

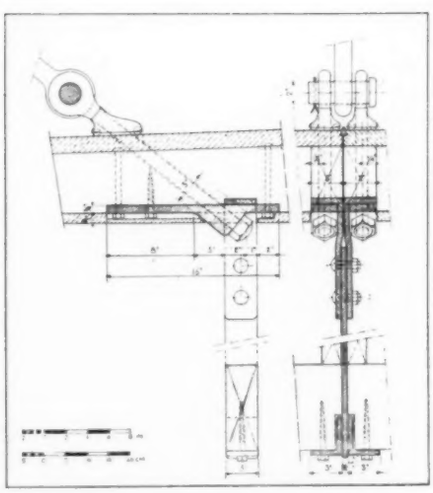


(1) Central House (2) Garage—2 cars (3) Children's Wing

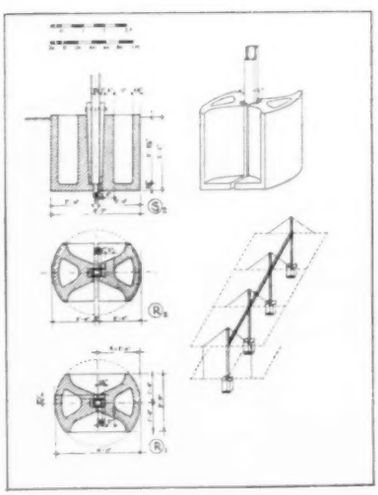
PROPOSED MULHALL COOPERATIVE FARMING COMMUNITY
IN SAN DIEGO COUNTY, CALIFORNIA



VIEW OF MODEL SHOWING SUSPENDED ROOF CONSTRUCTION



DETAIL OF ADJUSTABLE AND
SUPPORTING TENSION LINE



PREFABRICATED FOUNDATION
4-POST SUSPENSION SYSTEM

"ONE-PLUS-TWO" DIATOM HOUSE

RICHARD J. NEUTRA, ARCHITECT
PETER PFISTERER, ASSOCIATE
LOS ANGELES

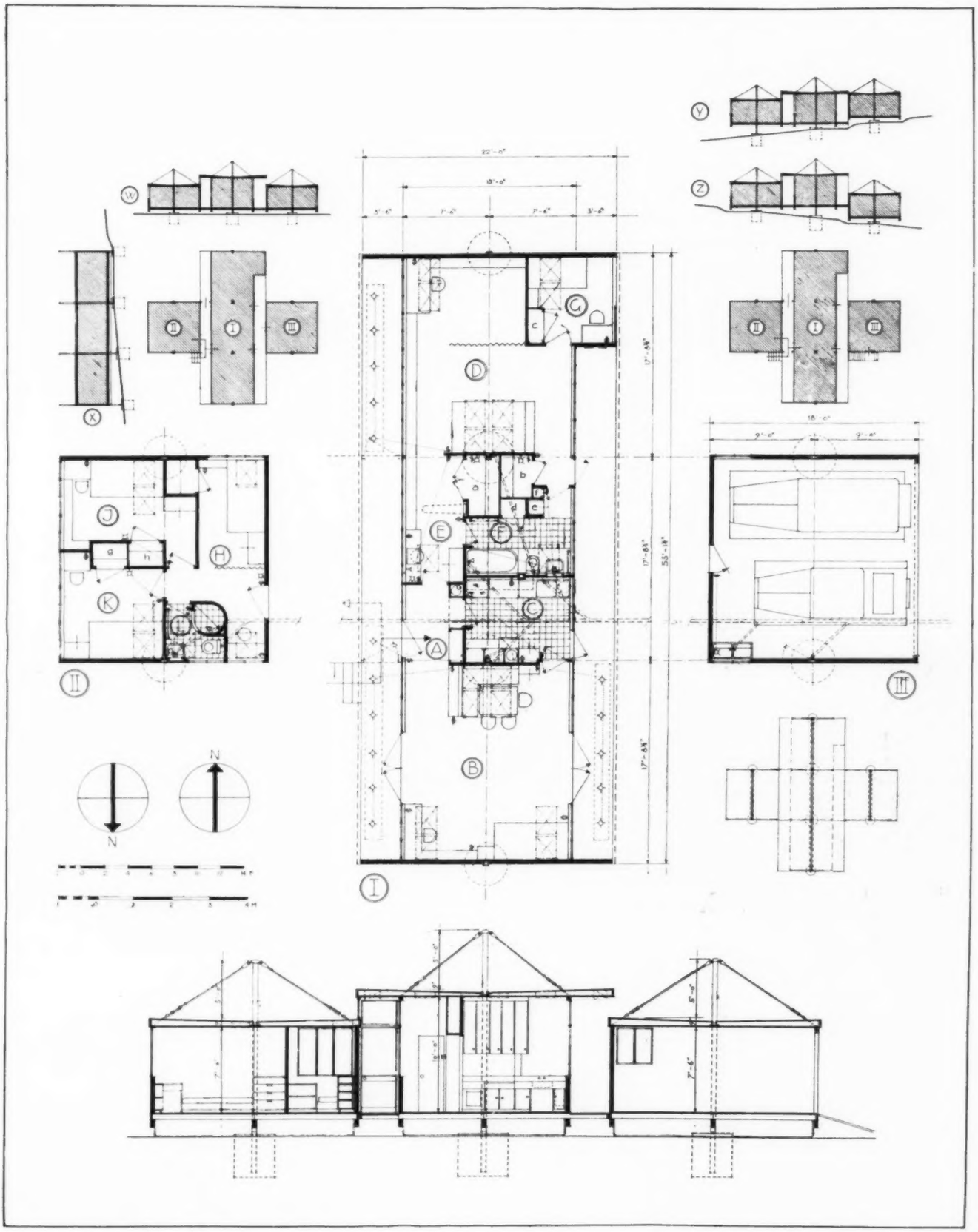
A shop-fabricated structure designed to permit three separate successive purchases. The central unit serves the smallest family group. Secondary elements for an expanding family are the children's unit and the garage unit. Houses can be arranged individually or in rows; a special type is used for hillside locations.

Estimated cost of central unit with sleeping porch and double garage: $1,750. Dependence unit for increased family group: $425. Prices include complete furnishings and would be decreased with increasing production.

Utilities: ceilings are low-temperature radiating metal panels. Indirect illumination provided by reflectors in ceiling which receive the light from vacuum tubes under outside roof projections.

Construction system: walls and roof of house units are suspended from four compression posts.

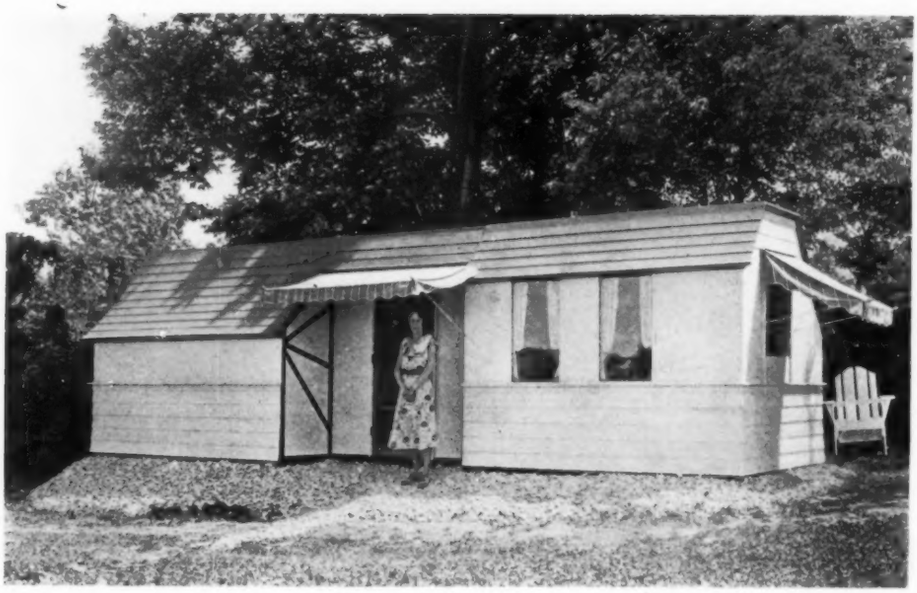
Synthetic structural material: a mineralized composition using infusorial earth as main ingredient and hardened under 8 atmospheres of steam pressure. This diatom composition is designed in various combinations for various requirements. In principle, the combination includes hydraulic binder, calcium hydrate, a fibrous material and resin as well as diatomaceous earth. Its minimum weight of 40 pounds per cubic foot can be further decreased for certain purposes by admixture of naphtalin as an evaporating agent that gives porousness. For moisture imperviousness the slabs before hardening are sprayed in the shop with a compound of hydraulic binder, water-repelling Ceresit or Colophonium, filler pigment and diatom powder to increase the interaction of the binder agent of upper and lower layers, and then the steam hardening of base and surface is accomplished in one process. No subsequent mechanical action can separate the surface layer from its base, and plaster surfacing is eliminated as a matter of course.



(I) CENTRAL UNIT (II) CHILDREN'S UNIT (III) GARAGE UNIT

Structural values: The Diatom composition has crushing strength of 1,100 pounds per square inch, elasticity modulus 130,000, low specific gravity, low thermal conductivity, fire resistance, simple workability and precision without shrinkage. Steel reinforcing used for structural members like beams and roof slabs. A double shell wall (1¼" slabs with 3" air space) equals insulating value of an 18" brick wall with only one-twentieth of its weight.

COTTON HOUSES



PORTABLE HOUSE NEAR MILWAUKEE

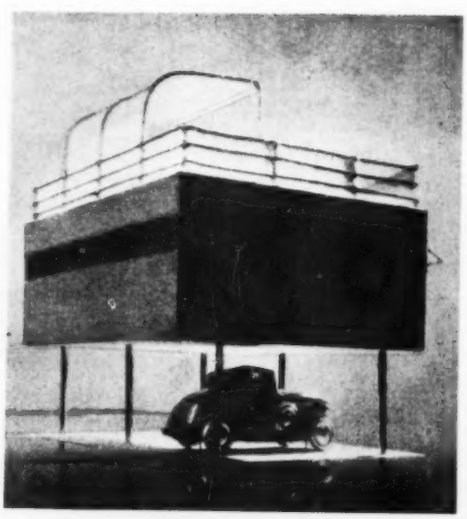
DESIGNED BY STANLEY W. NICHOLSON

This demonstration house, built and occupied by the designer, consists of two room-units weighing only 370 pounds and costing $220. It is expected that this house type will be soon ready to market in room-unit form throughout Wisconsin, Minnesota and other vacation sections in the middle west. The houses will be sold to campers through sporting goods merchandising channels at a price of less than $100 for each room-unit.

Each room-unit is standardized in size and shape, and can be fitted for kitchen, dining room, bedroom or living room. Smaller units are provided for bathrooms. As additional space is needed, other units can be easily aligned and joined to those already in place.

Features of demonstration house: hot and cold running water; air conditioning system; kitchen equipped with refrigerator, gasoline range and sink. Concealed fixtures make it possible to convert living room into a bedroom, combining essential bathroom facilities.

Structural system has been adapted from airplane construction by designer, an aviator. Each room-unit is a light but rigid wood structure, with exterior covered by an unbleached cotton sheeting. The cotton is given a coating of cellulose "dope" as applied to airplane wings. This paint waterproofs and shrinks the fabric tightly in place. The interior is completely lined with the same material and the wall cell is filled with a loose-pack insulating material. The floor, integral with the room-unit, is of double thickness with an intervening air space.



WEEK-END HOUSE—Designed by A. LAWRENCE KOCHER and ALBERT FREY

The use of canvas for the covering of outside wall and roof surfaces in place of stucco, clapboards or shingles in the fabrication of small low-cost houses was first demonstrated in this model of a week-end house developed with the sponsorship of the New Uses Section of the Cotton-Textile Institute.

EXPERIMENTAL BUILDINGS
U. S. DEPT. OF AGRICULTURE

BELTSVILLE EXPERIMENTAL FARM, MARYLAND

Under the supervision of Wallace Ashby, Chief of Division of Structures, U. S. Department of Agriculture, two canvas-covered sheds have been erected at the Beltsville Farm in order to study the life and utility of canvas as an outside covering for buildings, the effectiveness of different preservative and waterproofing treatments, and the ease of application with different kinds of sheathing and paints. Another new building using canvas is to be erected at the Delta Experiment Station in Mississippi in the near future.

The method of construction, as reported by J. R. McCalmont, Jr., agricultural engineer:

The wagon shed is ordinary shed construction with some variations in the sheathing requiring three men approximately 3 days to prepare it for the base treatments and canvas. The roof was sheathed with tongue-and-groove boards excepting two panels near the center of the roof which were covered with plywood flush with the sheathing.

The roof was divided into three sections for base treatment. A 6-foot strip along the south end was covered with hot asphalt, the center was untreated and an 8-foot strip along the north end was covered with white lead. The canvas strips were laid in the same manner explained for all canvas, the seams running with the pitch of the roof.

One end wall was covered with tongue-and-groove sheathing laid vertically, the other with plywood, and the back with tongue-and-groove sheathing laid part vertical and part horizontal. Plywood costs more per square foot than sheathing but there is less labor cost involved in laying it; the cost per square foot laid is about equal. It was thought desirable to have a canvas covering bonded to the sheathing and to accomplish this, three different base treatments were tried, hot asphalt, cold asphalt emulsion and white lead. The hot asphalt was easily applied but set up so quickly that the canvas could not be laid while it was still very soft, but had to be pressed into it. When the canvas was pressed into the asphalt it adhered very well. White lead had little or no holding power. Asphalt emulsion was the best preparation for a base treatment insofar as it was easily applied and held the canvas smoothly to the sheathing. Time is required to show how this treatment will set when it has dried thoroughly.

Four days were required to apply the base treatments, stretch and tack the canvas in place. Canvas is most easily applied by first fastening one end, stretching longitudinally, tacking the opposite end and finally tacking along the edges. Canvas must be stretched tight and smooth and tacked closely along all edges or it will separate from the base coat and become loose. Care must be taken not to stretch the canvas too much laterally when fastening the ends if its edges are to be kept straight. Canvas will stretch better the long way of the material, and after being stretched in one direction will stretch very little in the opposite direction. The change in moisture content will cause shrinking and stretching of canvas and if tacked too close to the edge of the strip the tacks will tear out of the fabric.

The value of the different paint treatments will develop as they have time to weather. Different paints and different colors in the same paint show a great difference in the amount of heat reflected and absorbed, which is expected to have an effect on the life of the canvas. The total time required for all the paint treatments was 2½ days.

The small shed, parabolic in cross-section, was built in 3 days. The ribs for the main part of the framing were made up of 3½" x 4" pieces of fir lumber. These pieces would break very easily at knots or points where the grain ran to the surface, and were not flexible enough to bend into shape without first soaking in water. Without clear uniform lumber it was also hard to bend the ribs to the same smooth curve, but with all having the same length the bracing and plywood sheathing on one half the roof and side kept them in line.

It was found that canvas can be laid better on a slightly convex surface than a plane surface, and it is easier to bond the canvas to the sheathing. This type of building would probably be less expensive than one using tongue-and-groove sheathing and canvas, and probably slightly more than one covered with drop siding alone, depending on the life of the canvas and the cost of the paint treatments used. Comparative cost between these methods of construction would depend on the locality in which the materials were bought.

When canvas is used there is no need for window or corner trim. The canvas can be carried around the edges of the window and under the window stops and drip cap. Trim boards would trap water and rot the canvas. Absence of trim cuts the cost of both labor and material.

Most of the paints cover the canvas well and appear to have furnished a waterproof surface. The canvas when painted was in good condition free from dirt and mildew.

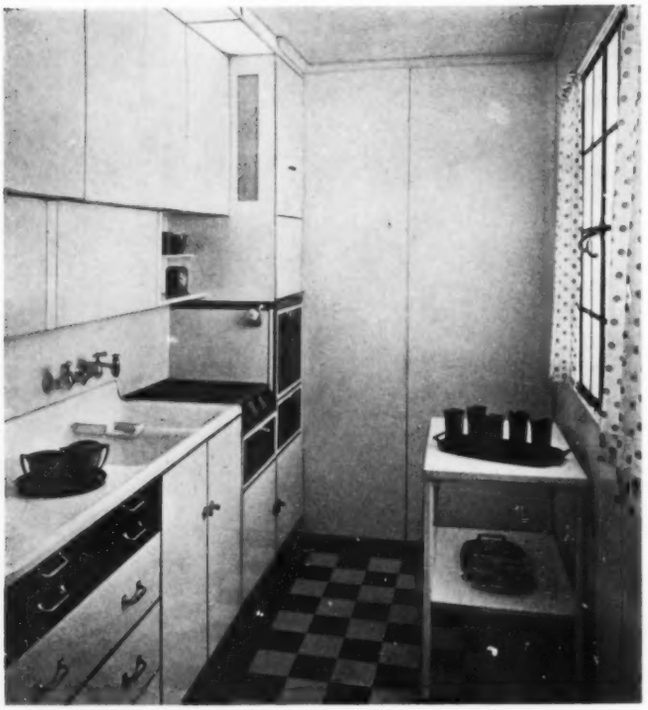
Large canvas-covered wagon shed. Note absence of window trim.

Small shed. Plywood is coated with asphalt before canvas is applied.

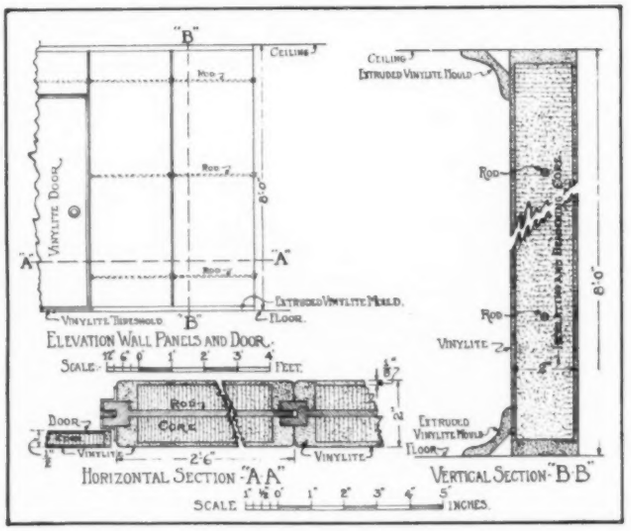
Canvas covering in place. No plywood used under canvas on south wall.

THE VINYLITE HOUSE

A 3-room apartment—kitchen, bath and living room—built as a demonstration of the use of Vinylite for standardized building parts. (See description on frontispiece plate of this issue.) Wall panels are bolted together by rods inserted through core.



VINYLITE CUPBOARD DOORS, WALL PANELS, FLOOR TILE

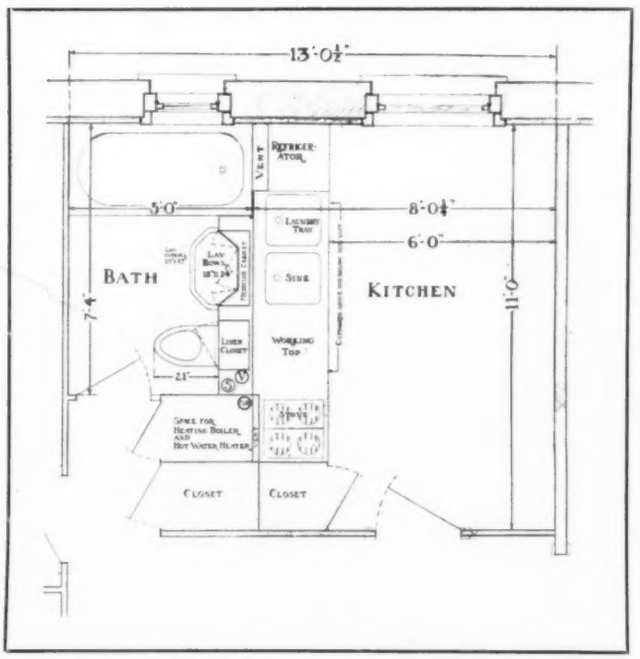


WALL PANEL CONSTRUCTION DETAILS

KITCHEN-BATHROOM UNIT

A prefabricated combination unit developed as part of the housing studies of John B. Pierce Foundation, New York City. (Reported by R. L. Davison at the National Conference on Low-Cost Housing, October, 1933, sponsored by Cleveland Engineering Society.)

Eddowes Co., Inc.



Backing up of kitchen and bathroom equipment eliminates need of partition wall. Combination delivered to building site as a single unit.

THE ARCHITECTURAL RECORD

THE CONSTRUCTION OUTLOOK

By THOMAS S. HOLDEN, Vice-President in Charge of Statistics and Research
F. W. DODGE CORPORATION

The construction industry, sickest of all sick industries a year ago, is very decidedly convalescent; it has many reasons for viewing the year 1934 with renewed hope and vigor. It has already seen substantial increases in volume of public and private work, it has the early prospect of the signing of a master code satisfactory to all elements of the industry, and a practical certainty of increased volume of activity in the coming year.

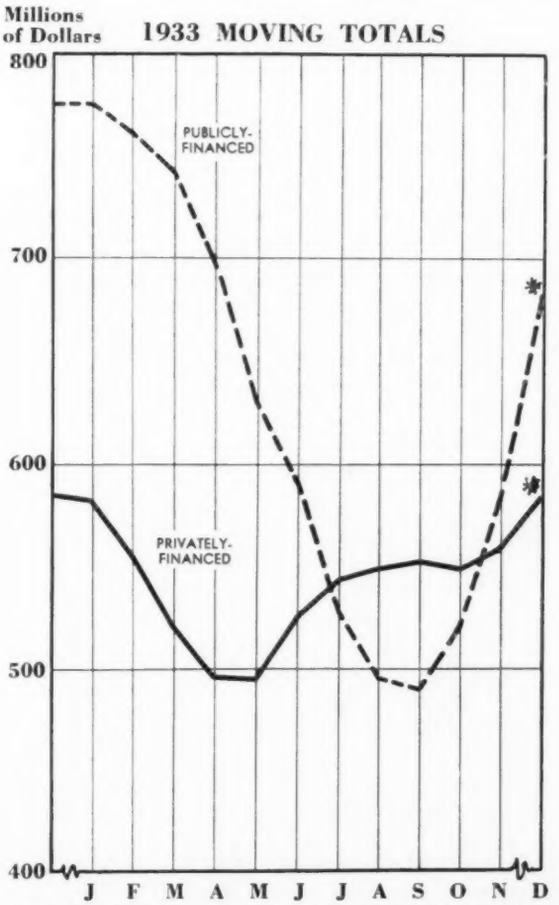
Public Works Program

Although the Federal public works program got under way several months after the upturn in private building activity, it was in magnitude the chief factor in recent increases of construction volume and is likely to continue as the largest factor through 1934. Practically all of the $3,300,000,000 fund had been allotted to specific projects by January 1, to projects in every state and territory. While some of the money is allotted to survey projects, reforestation, naval construction and the like, the bulk is for building and engineering construction. Most of the allotments will take effect as contracts and employment and material purchases in 1934. While engineering works predominate, hundreds of building projects have been approved, such as schools, hospitals, institutions, army housing, post offices, limited-dividend housing projects, new public buildings of all kinds, and repairs and alterations of existing public buildings. Inclusion of building projects in the program improves the outlook for architects, building craftsmen and other groups not employed in heavy engineering construction. Many of the engineering projects will be of indirect benefit to architects, through stimulating private building projects in the vicinity of new public improvements. The spread of purchasing power through public construction expenditures will have some effect on business confidence, real estate conditions and willingness to invest in new projects.

Planning Stimulated

The Federal public works program has not only provided money to carry through many hundreds of millions of dollars of construction work, it has also stimulated planning of many additional projects. At the opening of the year 1933 the creeping paralysis of deflation had practically strangled the will to plan new projects. F. W. Dodge Corporation used to record in single months of the boom years as much as a billion dollars in contemplated new projects reported in the early plan stage. By January 1933 the volume of contemplated new work had dwindled to $101,843,300, the lowest monthly total for many years. From January on there was a steady increase in contemplated work reported, up to $939,131,100 in November, the largest volume of new plans that had been reported in any month since April 1930. This remarkable upturn in the volume of new plans is shown in the accompanying tables and charts. The total volume of contemplated new work reported for the 37 eastern states in the year 1932 was only $1,838,340,000; in the year 1933 it reached the sum of $5,486,223,900 plus the figure for the final week of the year, unrecorded as this is being written. The total volume of new plans recorded in the year 1933 was three times as much as in the preceding year.

While this enormous volume of new planning was stimulated by expectation of Federal loans and



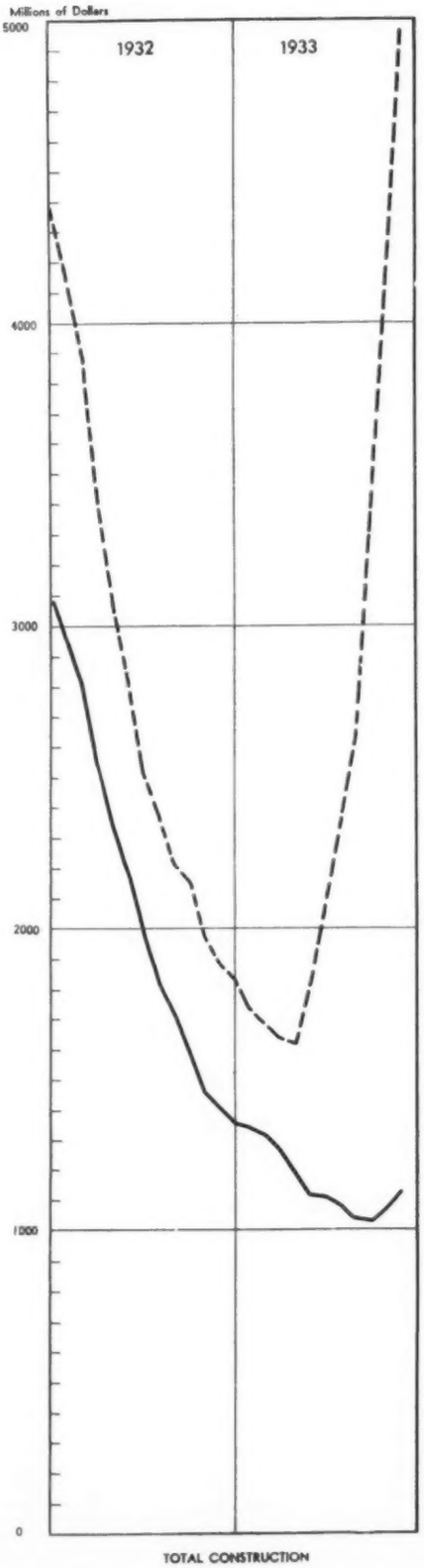
This chart shows how the revival of private work started in June, 1933, whereas the upturn in publicly-financed work did not come until October. Private work appears to have reached an irreducible minimum in 1933, having fallen only 2 per cent behind the previous year. As the year opens conditions seem favorable to continued moderate improvements in privately-financed work, along with very big increases in public work.

grants, it has not been confined to public projects. As shown in the charts and tables, every major classification of building and engineering work has participated in these increases; even the two classifications which do not show increases in the table for the first eleven months of the year (commercial buildings and religious and memorial buildings), show in the charts upturns for recent months.

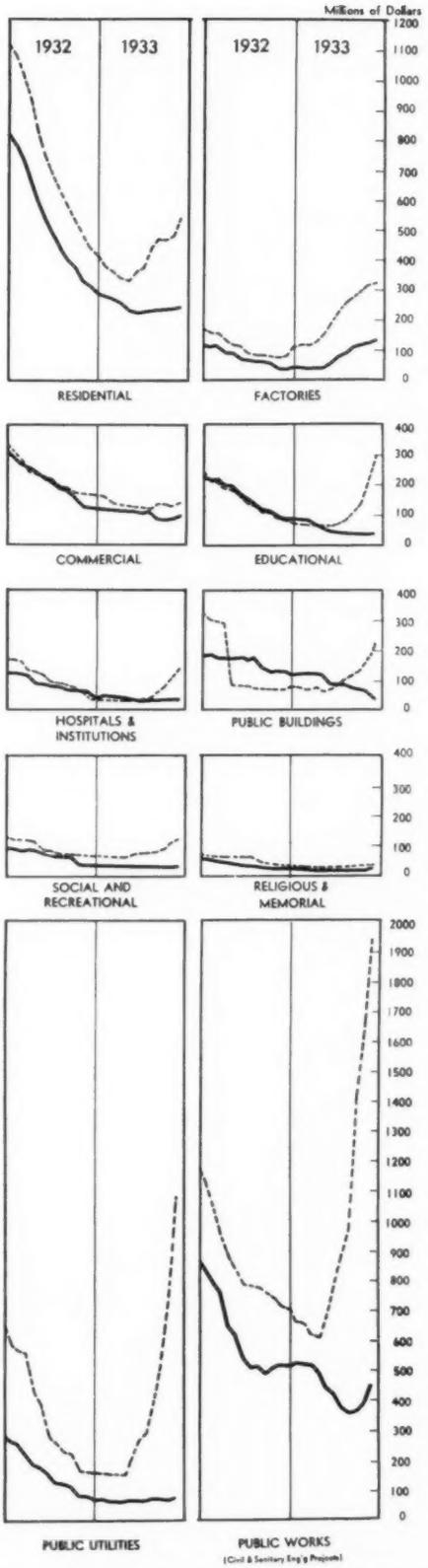
Unfortunately, we can not take these figures on new plans as any exact measure of the volume of contracts to be expected in 1934. The projects practically certain to go ahead are those for which definite allotments of Federal funds have been made. When Secretary Ickes announced recently that the $3,000,000,000 mark had been passed in Federal allotments, he also stated that applications had been received by the Public Works Administration for loans to other projects amounting to $3,000,000,000 more. The incoming Congress will have before it the question of increasing the public works fund. It has been reported that an additional $2,000,000,000 will be asked for. If Congress accedes to this demand, wholly or in part, it will be possible to advance the money very quickly to many additional projects. It is entirely possible that some communities, still solvent and awakened to a new interest in improvements, will carry projects through with their own financing.

Private Building Revived

As previously stated, privately-financed building and engineering work started upward well ahead of the public works program (see chart on page 37). As early as June contracts for private work exceeded the figure for the corresponding month of 1932, whereas it was not until October that publicly-financed work began to run ahead of the preceding year. During the six months from June 1 through November 30, 1933, privately-financed contracts awarded in the 37 eastern states amounted to $325,745,700 and exceeded the figure for the corresponding period of 1932 by 20 per cent. While residential building participated in this increase, the most spectacular increase was in factory projects, which had in 1933 three times the contract volume of the preceding year. Breweries played a large part, as distilleries will in 1934. New industrial construction is less dependent on the mortgage-money market than other private construction, and this has undoubtedly been an influence favoring this class of construction. The fact that obsolete plants and equipment have been written down in value is a stimulus to manufacturing companies to seek new locations, new branches, modernized buildings and equipment. Architects participated in the planning of new factory projects to a greater extent than ever before; except for small houses, factories accounted for a larger volume of architect-planned work that went ahead in 1933 than any other class of work. The outlook for continued increases in factory construction and modernization in 1934 seems very good.



In these charts the solid black curves represent 12-month moving totals of contracts awarded in the 37 eastern states; the broken curves represent 12-month moving totals of contemplated new work as recorded month by month. The increase in planning volume in 1933 was spectacular; while it was greatest in the engineering classifications (public utilities and



public works), it affected every other major classification of public and private work. The contract curves for five out of the ten major classifications have moved upward in recent months; factories, residential buildings, commercial buildings, public utilities and public works.

Other Signs of Progress

In the field of mortgage financing, progress has been slow. Government aid has thus far been extended principally to the small-house field. Liquidation of small-house mortgage difficulties by the Home Owners' Loan Corporation has made a good start. Aid to building and loan associations has assisted those institutions to prepare themselves for making new loans. Organization of new Federal building and loan associations has provided a number of communities with new institutions ready to lend on new mortgages. On November 19, 1933, John H. Fahey, Chairman of the Federal Home Loan Bank Board, announced that twenty charters had been granted to Federal savings and loan associations in seven states, and that preliminary approval had been given to 86 more in 26 states. Outside of the small-house field, progress has been made to the extent of more foreclosures out of the way, more distress property off the market, and signs of moderate improvement in real estate. Reopening of closed banks should be of some indirect aid to small-house building and modernization work.

Efforts will be made to persuade the incoming Congress to broaden the scope of the Home Loan Bank System, to finance individual owners and small-house developers, and even to create a national mortgage banking system for lending on all classes of property. How far the Government may go along these lines is a matter of conjecture at present; some liberalization of lending policies seems likely. Should the scope of Government financing be considerably expanded, the moderate increase in private work now expected for 1934 may be quite considerably accelerated.

The current civil works program is apt to provide a further stimulus to both private and public building activities. Immediate civil works projects will not include much contract work or much work requiring large bills of materials. They will include many local surveys and real property inventories which are apt to disclose building requirements in numbers of communities. The Government's housing and slum-clearance efforts will focus attention on the need for liquidation and rehabilitation of those bankrupt urban neighborhoods called blighted areas and slums and should lead to a well-defined slum-rehabilitation policy and program.

Signing of the master code for the construction industry presented by the Construction League of the United States, expected momentarily as this is being written, will mark a milestone of progress. Except for temporary emergency organizations, the numerous groups in the big general field of construction activity have had heretofore no strong national association representing all the diverse interests, acting to correct abuses nationally and locally, and integrating the several elements into a coordinated whole. Public discussion has also achieved for the construction industry a far more widespread recognition of its key function as pro-

ducer of capital goods and distributor of general purchasing power than it has ever enjoyed before.

Notable Turn of Trend

While 1933 was the lowest point of depression for the construction industry, and a quite extreme low point, the progress that has been made since the turn of the year has been notable. Contracts awarded in the 37 eastern states during the first half of 1933 were 35% less in volume than in the first half of 1932; the second half year ran approximately 20% ahead of the second half of 1932. Consequently, the outlook for 1934 is vastly improved; naturally, this improvement is to be measured in terms of upturn from depression levels, not in terms of approximating the volumes of previous big boom years.

Publicly-financed work should at least double in volume over 1933. Private work should continue on the upgrade, with a moderate but substantial increase. Since architects will participate very largely in the public building projects as well as in any increases in private work, they will most likely have a considerably larger volume of business than in either of the past two years.

CONSTRUCTION STATISTICS—Thirty-seven Eastern States:

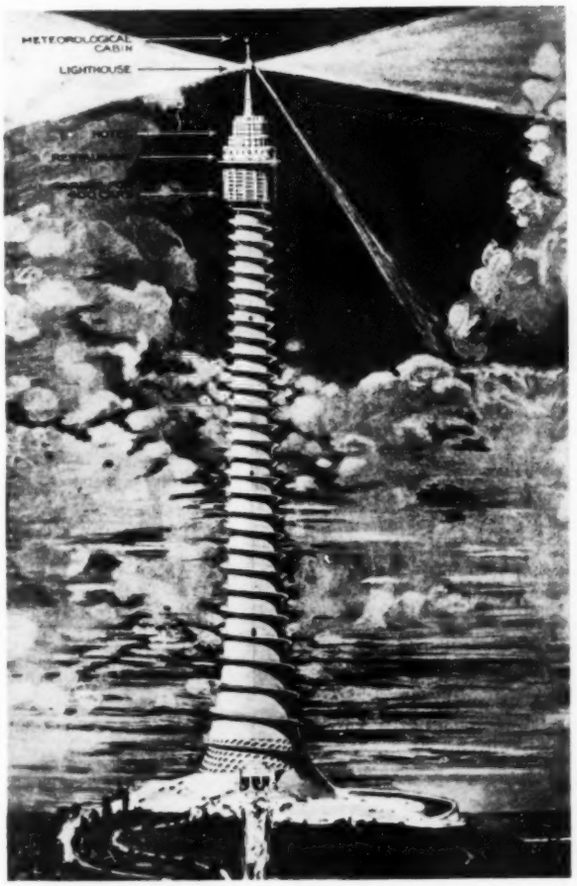
	Contemplated New Projects		Contracts Awarded	
	Entire Year 1932	11¾ Months 1933	Entire Year 1932	11¾ Months 1933
Commercial Buildings	$156,953,700	$151,255,000	$122,718,200	$97,766,300
Factories	102,720,700	314,073,800	43,490,900	126,734,000
Educational Buildings	75,822,900	393,837,100	82,307,500	36,803,800
Hospitals and Institutions	47,174,100	188,050,600	48,353,000	36,924,400
Public Buildings	73,295,100	243,114,700	117,982,500	48,994,300
Religious and Memorial	39,113,900	36,237,500	27,255,000	17,528,100
Social and Recreational	65,052,000	134,745,800	38,682,500	29,349,500
Residential Building	410,835,300	642,117,100	280,067,900	247,019,700
Public Works	708,058,900	2,136,364,500	514,699,700	482,006,800
Public Utilities	159,313,400	1,246,427,800	75,601,500	99,486,500
TOTAL CONSTRUCTION	$1,838,340,000	$5,486,223,900	$1,351,158,700	$1,222,613,400

These figures indicate the distribution of new plans among the major classifications of work. While biggest increases have taken place in plans for public works and public utilities, all other classes have had increased plan volume. In two classes (commercial buildings and religious and memorial buildings) increased plan volume came late in 1933 (see chart on page 39) but in insufficient amount to put the year's total for those classes ahead of 1932. In the contract tables the outstanding feature is the big increase in factory projects. Four other classes had contract increases in late months of 1933: residential buildings, commercial buildings, public utilities, and public works (see charts on page 39). The total for the full year 1933 was only about 7 per cent under that of 1932.

PRIVATE AND PUBLIC WORK REVIVED IN 1933 Contracts Awarded—37 Eastern States

	Privately Financed		Publicly Financed	
	1932	1933	1932	1933
January	$45,454,200	$43,876,300	$39,344,200	$39,479,700
February	55,373,200	26,075,800	33,672,600	26,636,500
March	67,422,100	34,752,300	44,812,400	25,206,200
April	61,175,000	38,933,800	60,529,800	17,639,200
May	53,673,000	53,487,500	92,548,200	23,684,200
June	48,806,800	73,520,900	64,268,200	28,821,000
July	43,504,700	62,469,700	85,264,000	20,084,700
August	52,885,700	58,741,300	81,102,400	47,247,600
September	47,426,000	46,744,800	80,100,700	73,389,600
October	46,348,100	44,805,900	60,925,800	100,561,300
November	32,215,200	35,797,300	73,087,100	126,543,300
December	29,207,300	51,346,700	52,012,000	155,962,800
TOTALS	$583,491,300	$570,552,300	$767,667,400	$685,156,100

ILLUSTRATED NEWS



Keystone

This proposed French structure will dwarf the Empire State building. In connection with plans for the Paris Exhibition of 1937, the construction of a huge tower of reinforced concrete, about 2,300 feet high, to be known as the Phare du Monde (Lighthouse of the World), has been suggested. It would be more than double the height of the Eiffel Tower (984 feet), and nearly twice that of the world's tallest skyscraper (1,248 feet). Besides interior elevators there would be a spiral outside motor-track leading to the first platform some 1,600 feet above the ground, with a garage for about 400 cars. A small track for light cars would ascend to another platform about 300 feet higher with a restaurant to accommodate about 2,000 people. Higher still would be a solarium for sun bathing and, above the lighthouse, a meteorological cabin. The engineer is M. Freyssinet.

The Miller Hospital is now under construction in Duluth, Minnesota. The present structure is being erected at a cost of $200,000 and will have a capacity of 50 beds; when finally completed the hospital will accommodate 150 beds. Erickson & Co. and Ellerbe & Co. are the associated architects.

THIS ARSHETECTURE

In Washington, U.S.A. (*reproduced from* STONE).

Reproduced in turn from THE ARCHITECTS' JOURNAL (London)

An English view of American architecture.

ANCIENT PERSIAN PALACE SCULPTURES AND A STONE AGE VILLAGE UNEARTHED BY AMERICAN EXPEDITION

Recently discovered sculptures in the ancient buildings of Persepolis are described in a report to Dr. James H. Breasted, Director of the Oriental Institute of the University of Chicago by Dr. Ernst Herzfeld, field director of the Institute's Persian Expedition at Persepolis, twenty-five hundred years old capital of the ancient Persian Empire, about forty miles from Shiraz. Two miles from Persepolis the expedition has found a 6,000-year old Stone Age village, with houses containing the earliest known windows ever found. Here lived the forebears of the Persian emperors, and in some of the rooms have been found the dishes and utensils from which they last ate some six thousand years ago.

Dr. Herzfeld has uncovered a series of wall sculptures which if set together would form a vast panel of reliefs five or six feet in height and almost a thousand feet in length. "The discovery is one of the greatest and most important in the history of archeological research anywhere," said Dr. Breasted. "It not only far surpasses any archeological disclosure ever made in the history of such research in Persia, but there has never been any discovery like it anywhere in Western Asia since archeological excavations began there almost a century ago."

The walls of the splendid palaces which stood on the gigantic terrace of Persepolis overlooking a mighty plain encircled by mountains, were of sun-dried brick, but the colonnaded halls, the windows, and the great doors were done in black stone which was polished like ebony.

The friezes and sculptured scenes were embellished with colors now all lost except in one relief just discovered by Herzfeld. It had been sheltered from the weather under rubbish for centuries. Now uncovered, it reveals the Persian Emperor wearing a robe bordered with scarlet and purple, shoes of scarlet, and other finery in royal hues.

First glimpse of the Stone Age village near Persepolis at the beginning of the clearance. The adobe walls of these houses were built six thousand years ago.

It was due to the disintegration and final fall of the great mud-brick walls that the newly discovered sculptures were preserved, and protected from the ravages of weather and vandalism through the nearly 2,500 years since they were created. The carvings, which include a series of historical inscriptions of the greatest importance, are as fresh as the day when the sculptors' chisels touched them for the last time.

"One tradition has it," said Dr. Breasted, "that Alexander the Great in 330 B.C., sotted with wine and urged on by his lady-love of the moment, set fire to the roof of one of these palaces, and thus sent up in flame and smoke a supreme expression of ancient Oriental genius.

"It was a disaster which marked the end of the evolution of Oriental civilization in Western Asia, and the destruction wrought by that conflagration devastated and wrecked forever most of the works of art which made the palaces of Persepolis the great world center of culture and civilization under the Persian Empire.

"When the Moslems overflowed into this region in the seventh and eighth centuries of the Christian Era, they battered to pieces the heads and faces of the sculptured figures they found still visible above the ground at Persepolis. But the sculptures which the Oriental Institute has now discovered escaped their notice."

The subject matter of the reliefs is a magnificent *durbar* representing a great group of Persian and Median officials standing with the gorgeous uniformed palace guards of the Persian Emperor drawn up at one side to receive the ambassadors of twenty-two subject nations who approach from the other side bearing their tribute to Persia. The execution of the scenes displays unparalleled beauty and refinement of detail. The palace guards, consisting of footmen, horsemen, and charioteers, form a superb ensemble. In the sculptor's representation of each chariot wheel, the bronze nail which was dropped through a hole in the end of the axle outside the hub to prevent the wheel from coming off is depicted in every detail; and the upper half of each nail consists of a beautifully sculptured female figure, carved with the delicacy of a cameo in an area not as large as a postage stamp, the legs of the figure forming the stem of the nail which is inserted in the hole in the axle.

Within two miles of Persepolis, Dr. Herzfeld has found a small mound some 300 by 600 feet in area and only ten or twelve feet in height, which when excavated has been found to cover a Stone Age village in a state of preservation surpassing any such discovery ever made heretofore. It dates from about 4,000 B.C.

(Left) Relief from small stairway at Persepolis showing two tribute bearers. (Right) Monumental stairway at front of palace. The uppermost reliefs on top course of blocks were knocked off by fall of sun-dried brick wall above; the blocks have been discovered lying uninjured at base of wall and will be replaced by expedition.

The walls of the *adobé* houses are preserved in places to a height of six or seven feet. There is a narrow street or alley extending the length of the little settlement, and a modern visitor walking along it can look over into the houses. Through the doors, and the earliest known windows ever found, one can see mural decorations of red ochre water color still discernible on the walls. Still standing about on the floors are household utensils of pottery, fireplaces with burned clay fire-dogs still in position, and pottery vessels still containing the remains of food, especially the bones of probably domesticated animals. In some of the dishes lay the flint knives with which these ancient people had last eaten about 6,000 years ago.

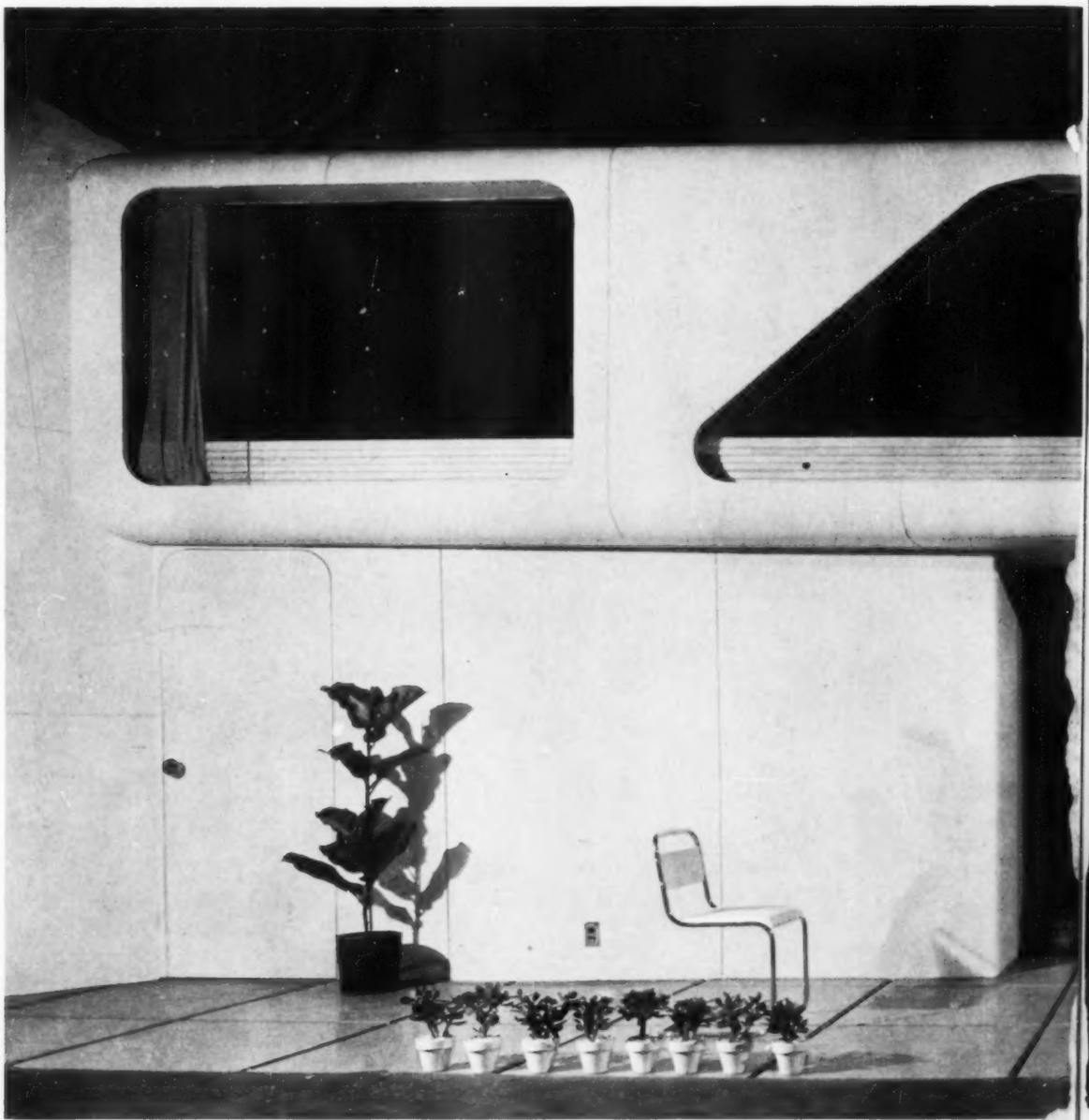
The Oriental Institute holds a concession to all the surrounding ancient sites within a radius of ten kilometers, or a circle of thirteen miles with Persepolis at its center. The Oriental Institute's Persian Expedition, headed by Professor Ernst Herzfeld, is engaged in recovering the long cultural development which went on for ages among the Persians and their predecessors in this region, as they advanced from the remote Stone Age to the magnificence of Cyrus the Great and the Persian emperors at Persepolis.

HISTORIC ARCHITECTURE TO BE SAVED FROM OBLIVION

To save from "unrecorded oblivion" the nation's historic buildings, the American Institute of Architects announces the appointment of four members of a National Advisory Committee: Dr. Leicester B. Holland, chief of the Division of Fine Arts of the Library of Congress; William Graves Perry of Williamsburg, Va.; Albert Simons of Charleston, S. C.; John Gaw Meem of Sante Fe, N. M. Three other members will be named by the Director of the Office of National Parks, Buildings, and Reservations.

The purpose of the program, framed as a civil works measure to provide immediate employment for 1,000 or more architects, is to record "interesting and significant specimens of American architecture." The advantages, it was stated, are that men could go to work at once, and that a very minimum of equipment, supplies, and overhead is necessary.

The plan embraces every type of antique structure in America from the Colonial architecture of the Atlantic Seaboard and the traces of Spanish culture in the South and Southwest to the prehistoric remains in New Mexico and the Russian remains in Alaska. Excavations of aboriginal ruins, and the making of complete records of the "decomposing cities" of the old mining settlements are contemplated. Residential buildings ranging from the birthplaces of Presidents to the hewn log cabins of the early pioneers are included.



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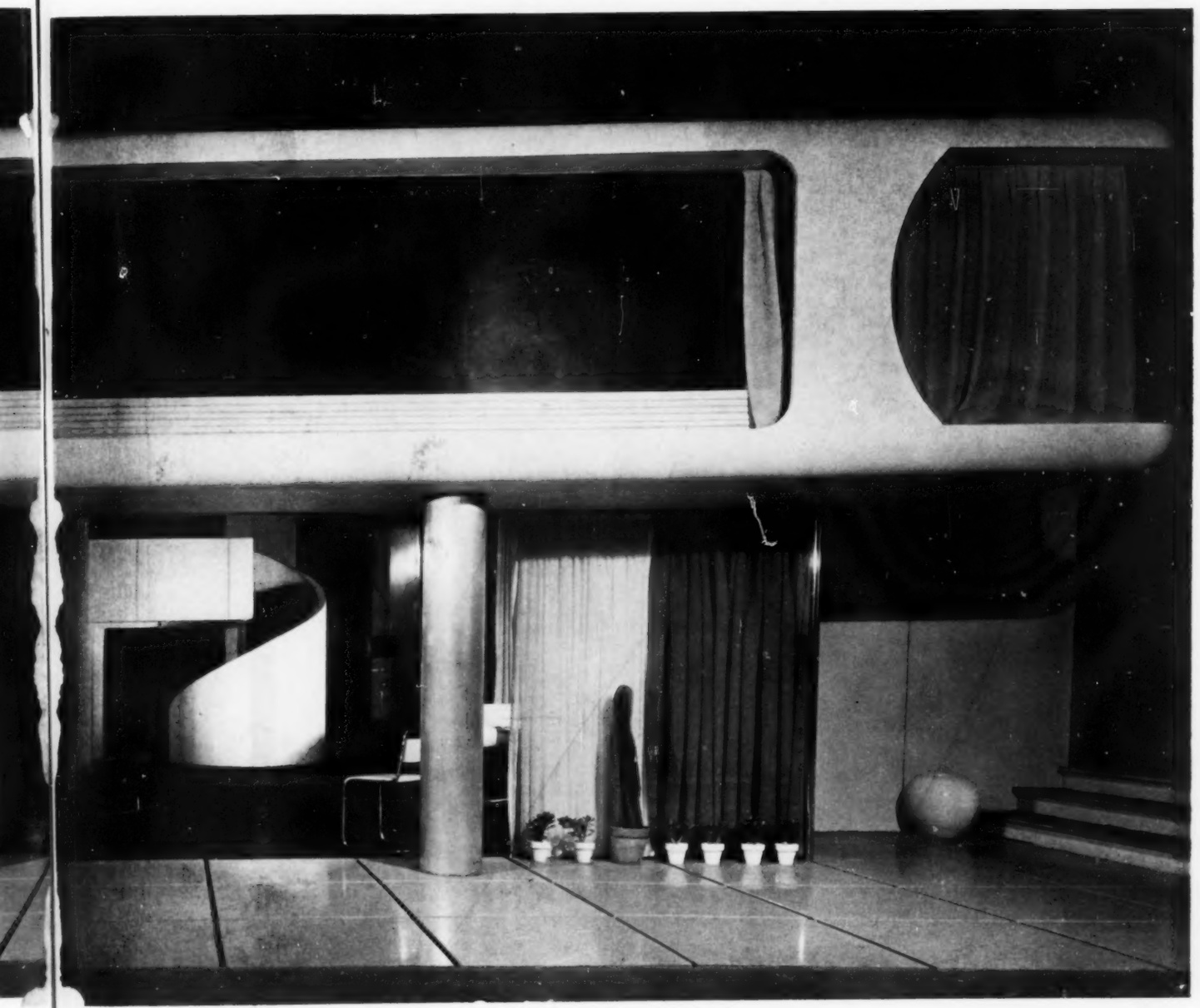
SPACE HOUSE

By FREDERICK J. KIESLER, ARCHITECT



Floor view of the Space House. Designed as one living space convertible into several rooms. The shell of the house is continuous tension, a construction principle developed to reduce deadload and to eliminate column support. (The column seen in the illustration could not be removed from exhibition floor.) The shell of the house is intended for die-cast unit construction. The view of the interior through the movable plate glass, on the main floor, is toward the living-sector of the house with the winding staircase leading over a small bridge into the segments for sleeping, on the mezzanine.

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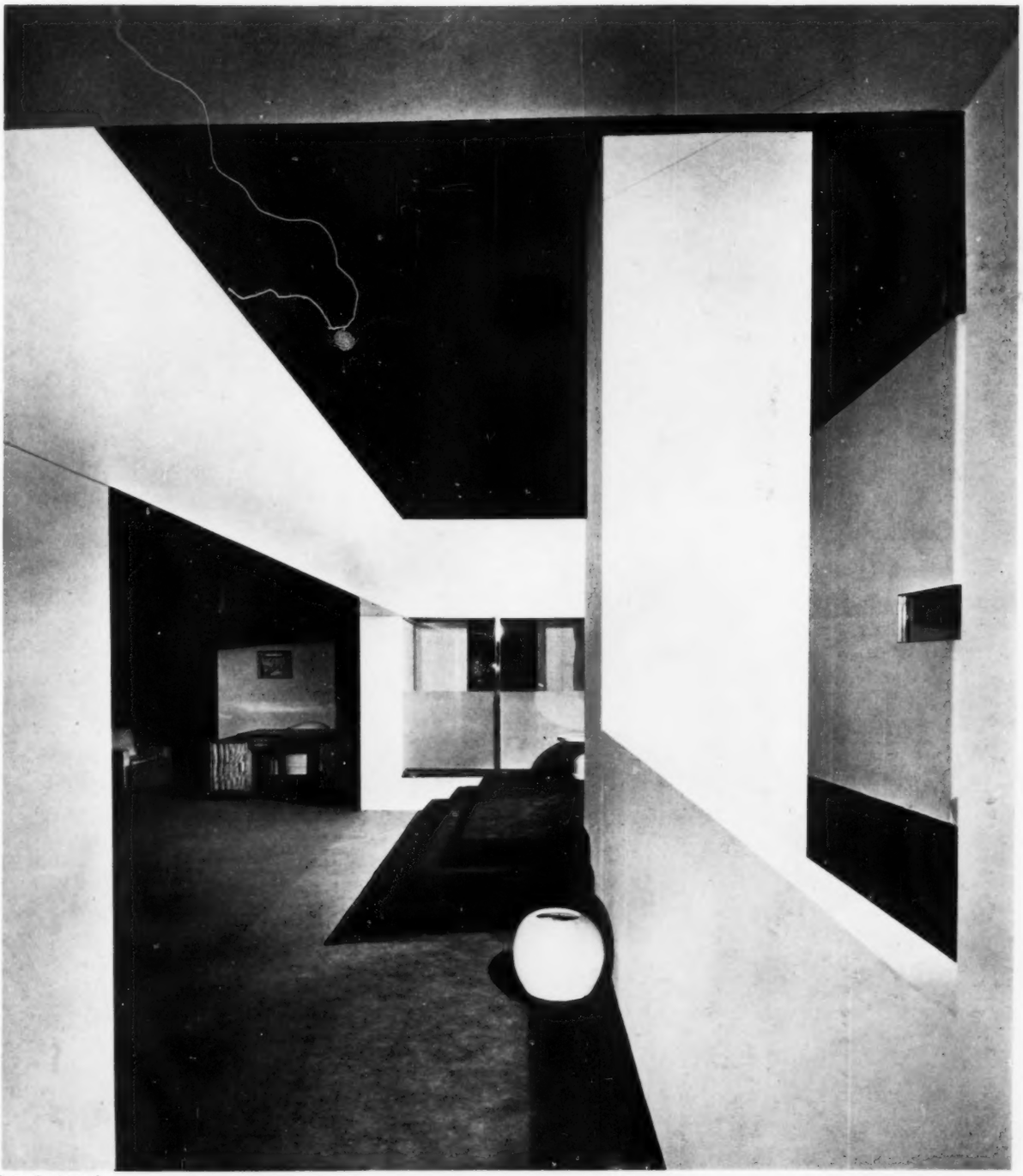
Stairway of exhibition hall adjoining Space House.

SPACE HOUSE
FREDERICK J. KIESLER, ARCHITECT



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Interior of space house: Dining space (to the left), living segment (behind staircase), library (under the mezzanine), study (in front) may all be thrown open into one large unified space-unit. These elements vary in height, depth and length; they are planned on four different levels. The design is an interpretation of the architect's theory of Time-Space-Architecture.

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SPACE HOUSE
FREDERICK J. KIESLER, ARCHITECT

Photo mural by Frederick Kiesler: "Determination" (Labor and Play).

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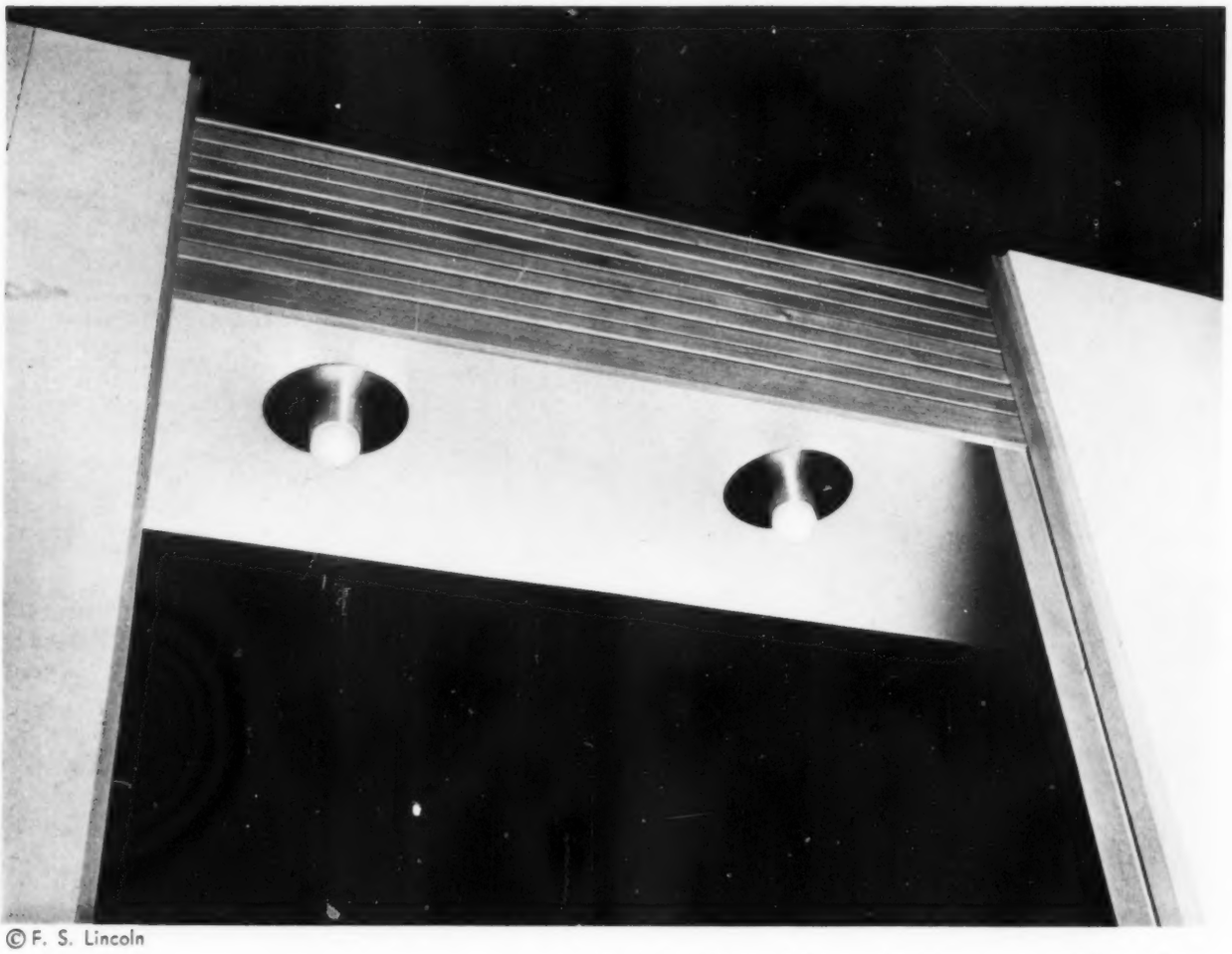
Tubular lighting fixture on mezzanine floor of showroom.



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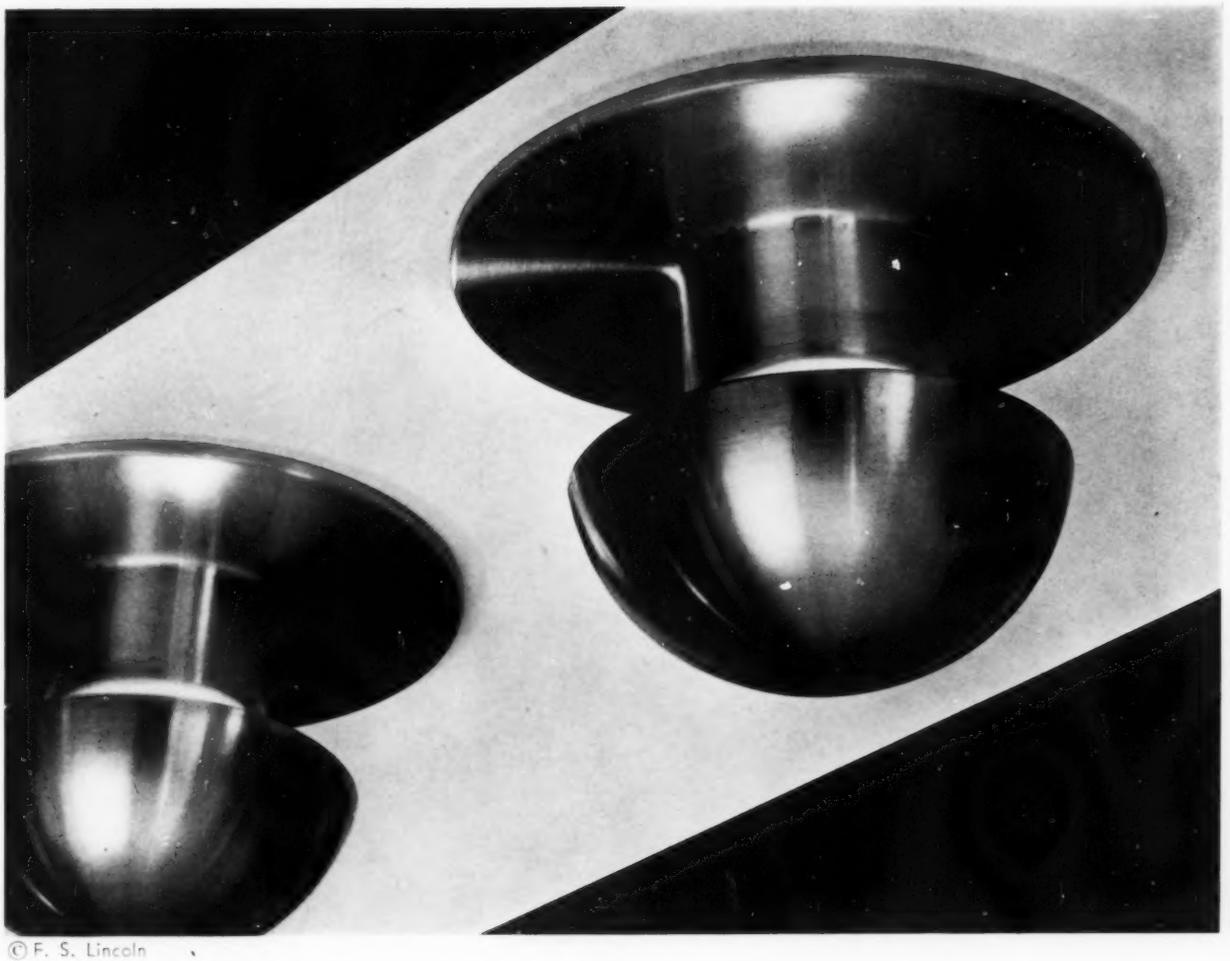
Lighting fixtures of spun aluminum over roll-down door.

MATERIALS OF SPACE HOUSE
FREDERICK J. KIESLER, ARCHITECT



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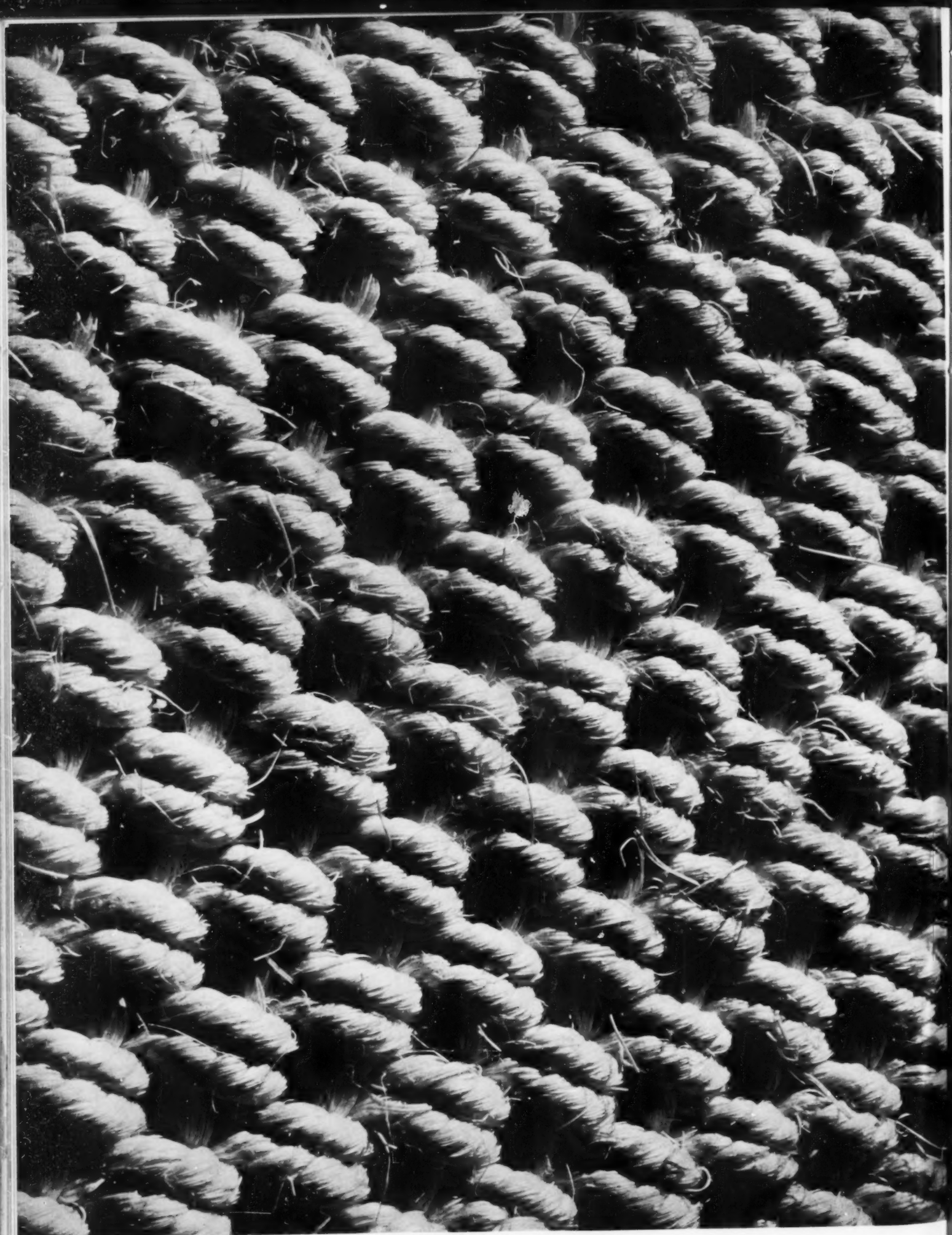
Lighting fixtures used throughout the house, in some cases with bulb exposed; in other cases, as in this illustration, with cup covering bulb. These fixtures are of aluminum, about 8 inches in diameter.



MATERIALS OF SPACE HOUSE
FREDERICK J. KIESLER, ARCHITECT

Jute matting used as floor covering.

F. S. Lincoln

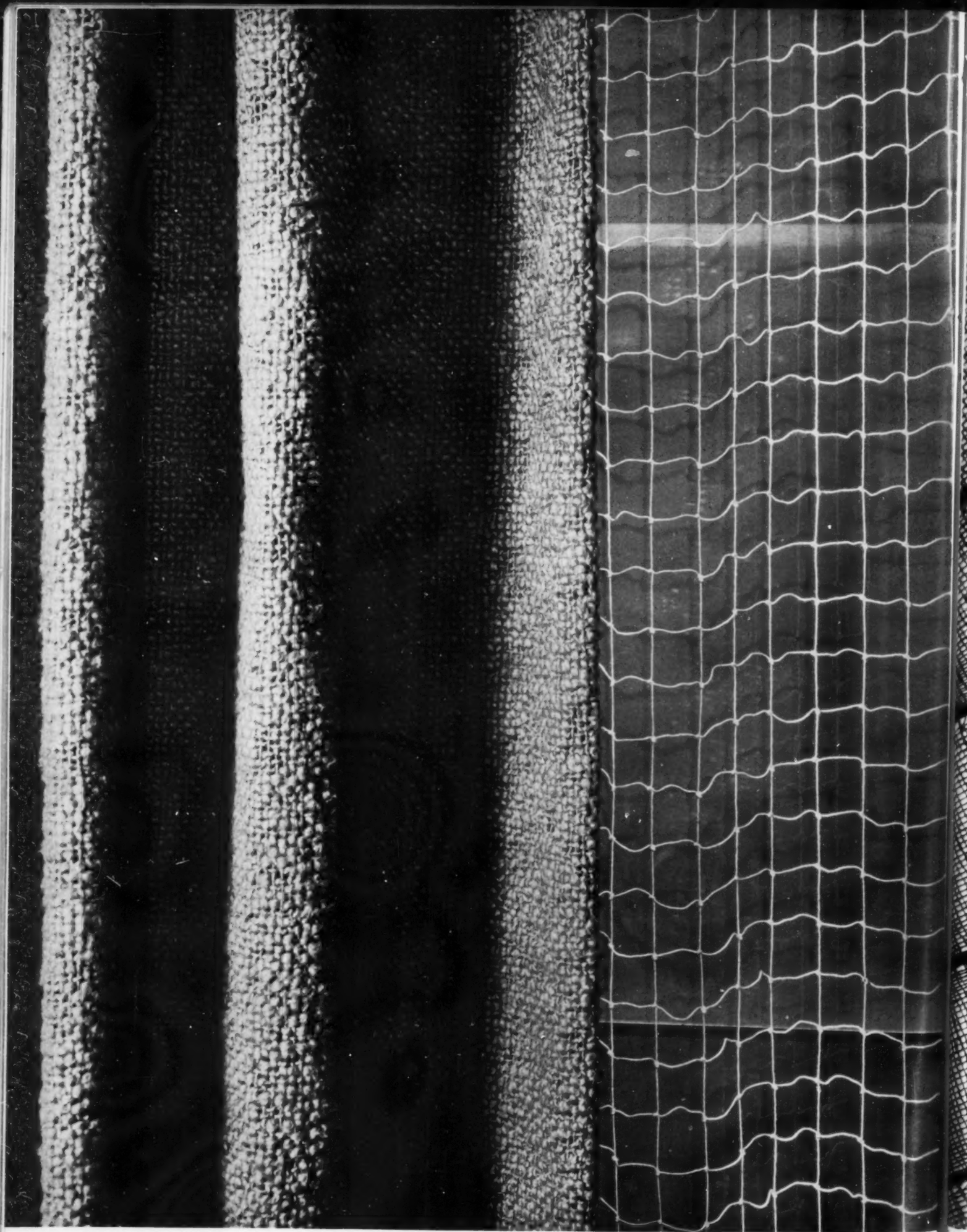
Straw floor matting in carpet width and continuous roll.

© F. S. Lincoln

Drapery material used in living room.

MATERIALS OF SPACE HOUSE
FREDERICK J. KIESLER, ARCHITECT

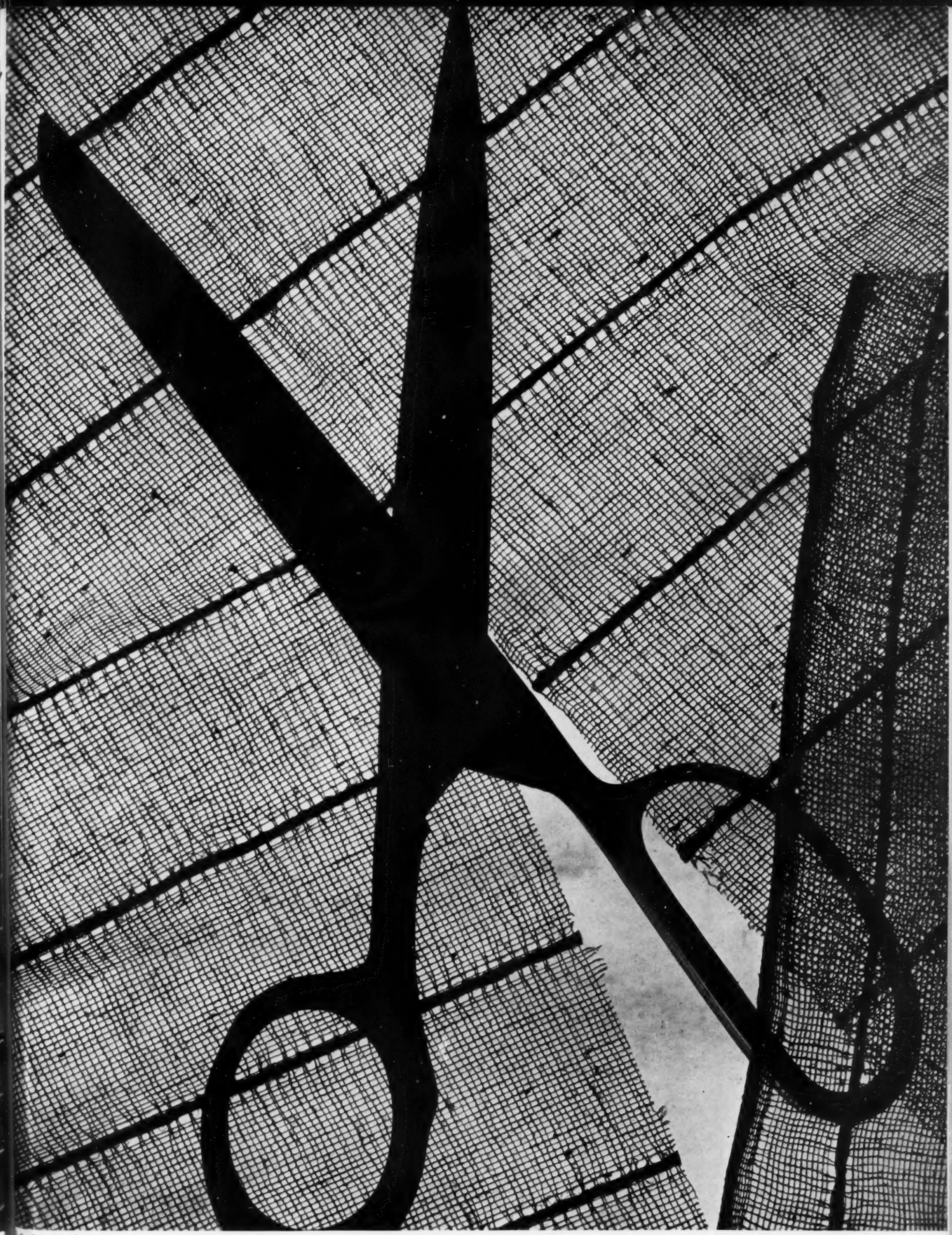
Curtain in dining room, that can be opened or closed as desired.



MATERIALS OF SPACE HOUSE
FREDERICK J. KIESLER, ARCHITECT

Coarse brown drapery obscures vision; fishnet admits air and light.

F. S. Linc



F. S. Lincoln

Net fabric used for ceiling. This material is reinforced with hemp twine to permit drawing material taut.

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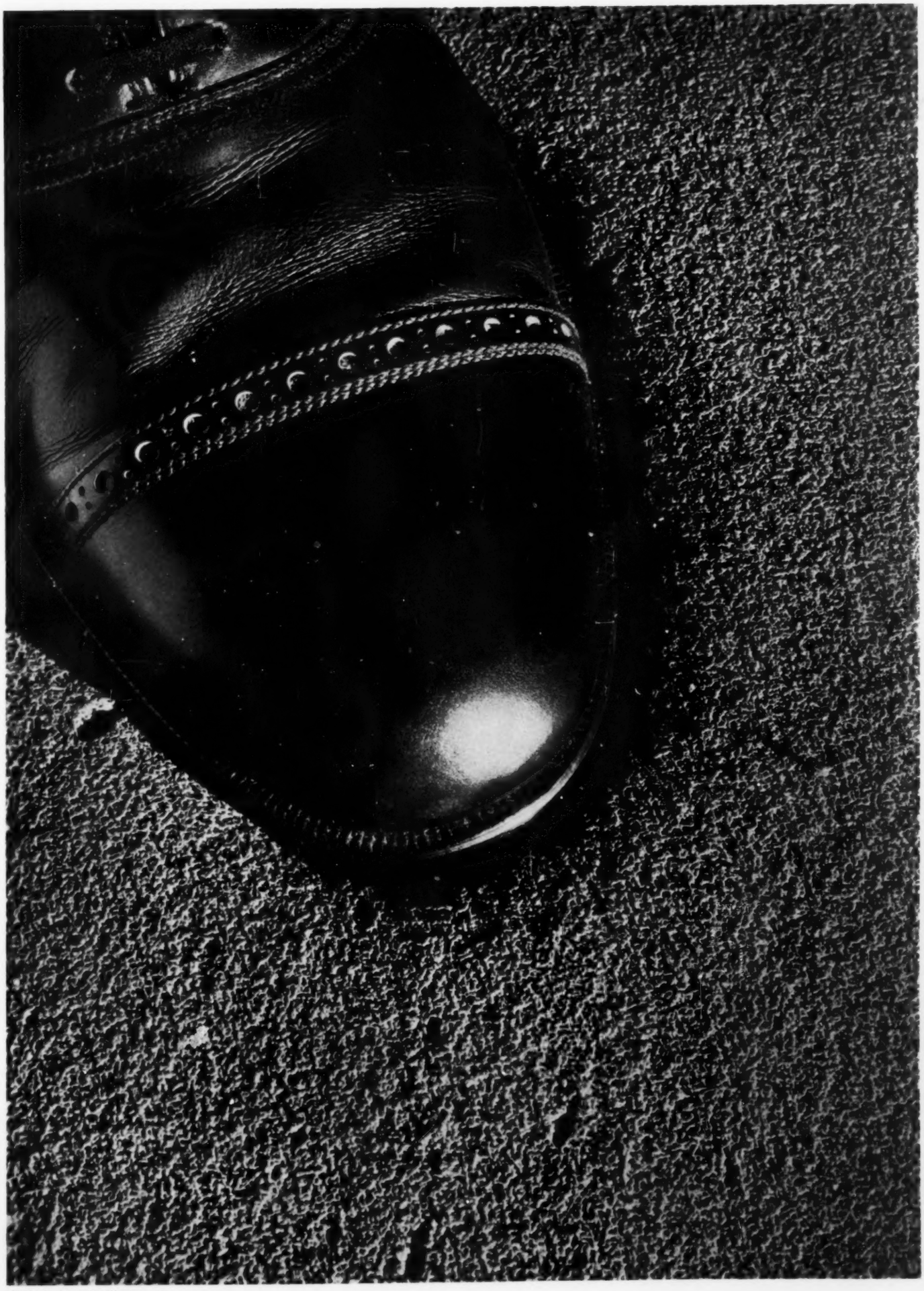
MATERIALS OF SPACE HOUSE
FREDERICK J. KIESLER, ARCHITECT

Sponge rubber curtain approximately 3/16" thick.



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Sponge rubber used as floor covering.

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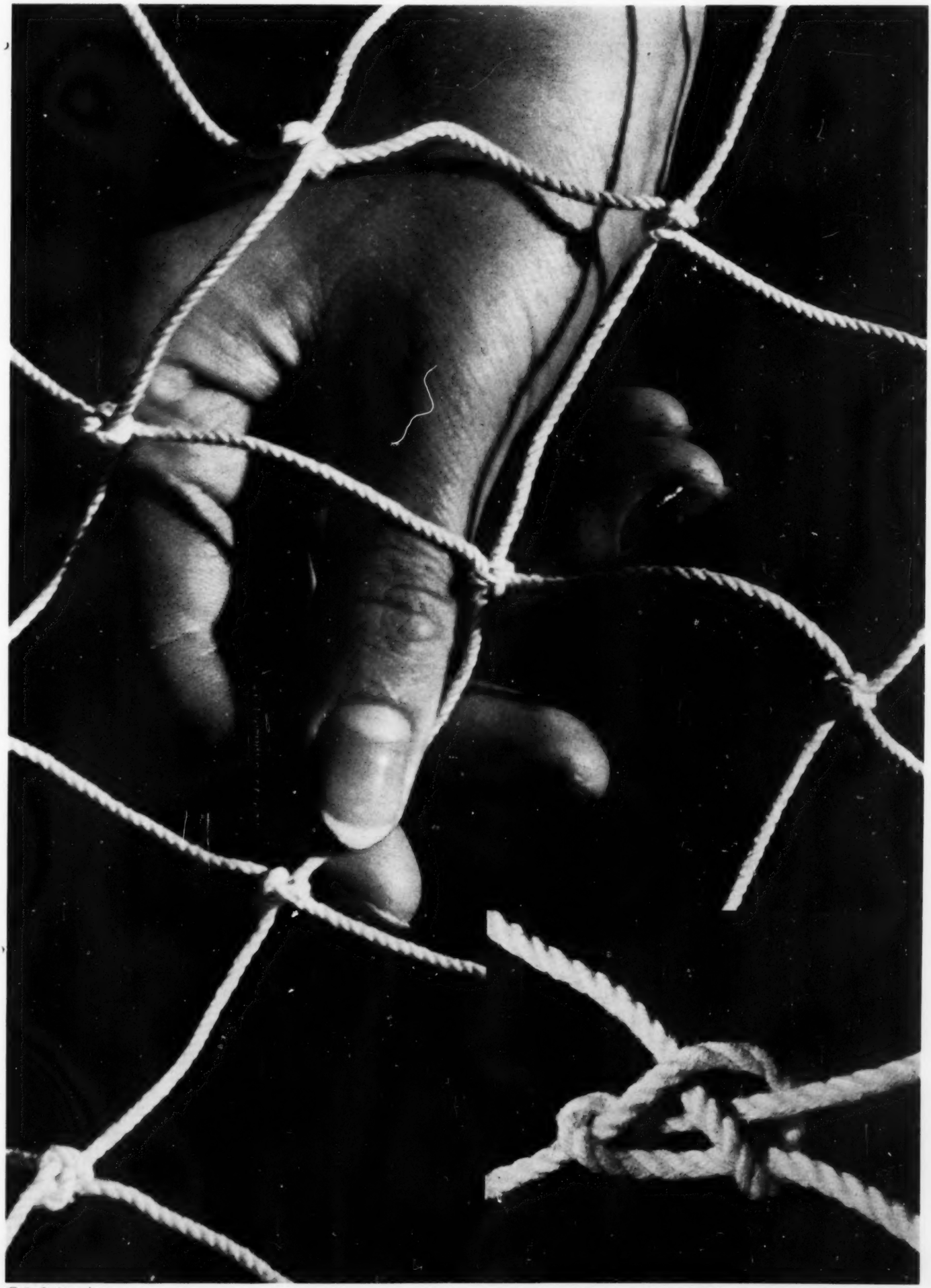
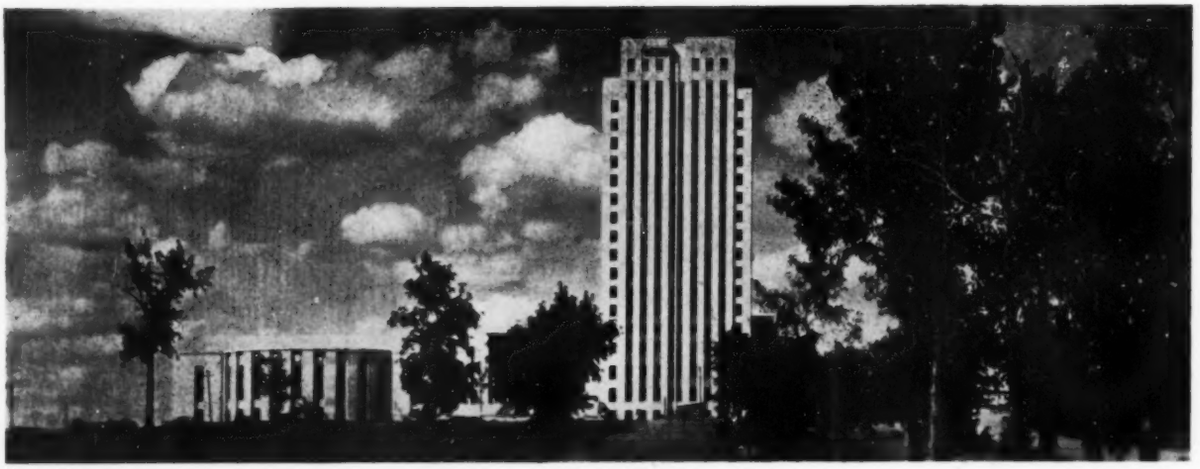
The fishnet may be drawn to cover the window entirely or translucent fabric at left can be used to give privacy.

MATERIALS OF SPACE HOUSE
FREDERICK J. KIESLER, ARCHITECT



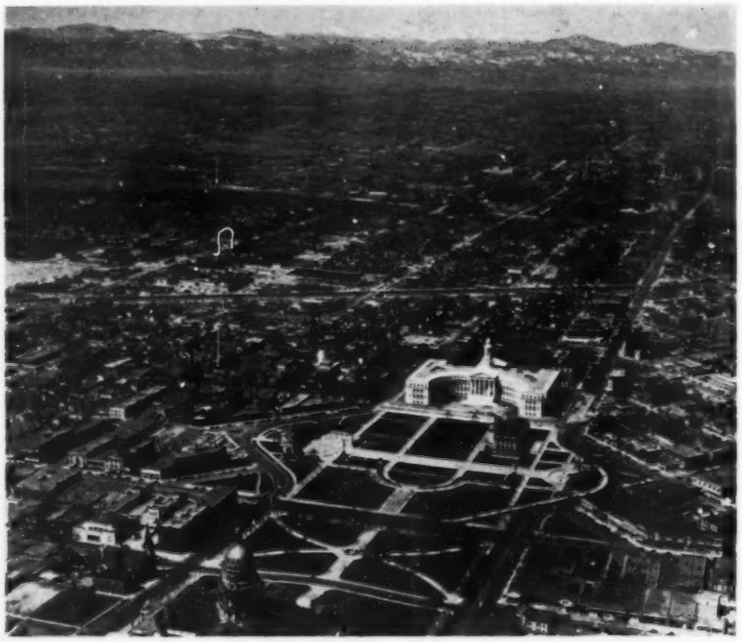
© F. S. Lincoln

Detail of twine curtain shown on opposite page.



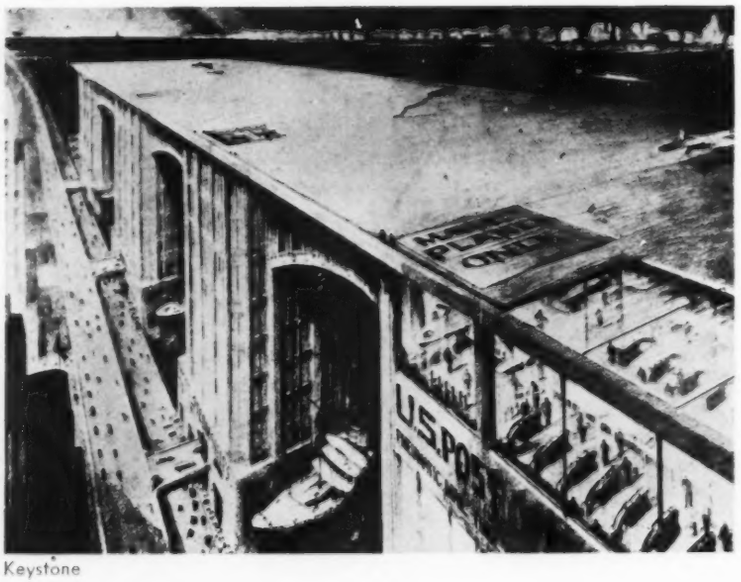
Keystone

The new Capitol Building at Bismarck, North Dakota, which replaces the old capitol building destroyed by fire in 1930. It has been built at a cost of two million dollars. Holabird and Root are the architects.



H. G. Eisenhand

The new Denver City and County Building is shown in this air view of the Civic Center. The building was originally planned by the Allied Architects Association of Denver. George S. Koyl did the greater part of the designing for the building; the active architect in charge is Roland L. Linder.



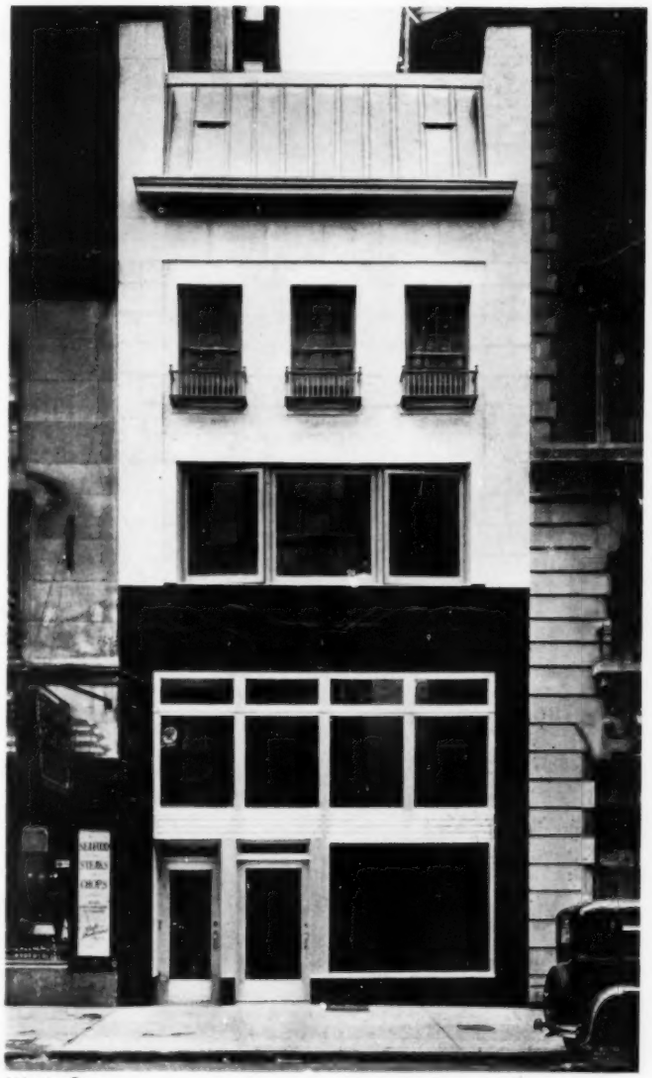
Keystone

Combination air and marine terminal. Two New York architects, L. A. Reinhard and Henry Hofmeister, collaborated with Commander Frank M. Hawks to develop this plan for a super-landing field above New York's steamship docks. The field would be 3,000 feet long and 800 feet wide, and high enough to permit ships to dock below. The scheme has been proposed for study as a self-liquidating project under the NRA program. The drawing is by Hugh Ferriss.

MODERNIZATION

ALTERATION TO 130 WEST 45th STREET, NEW YORK CITY

FRANK A. ROOKE, ARCHITECT



Wurts Bros.
BUILDING FRONT AFTER ALTERATION

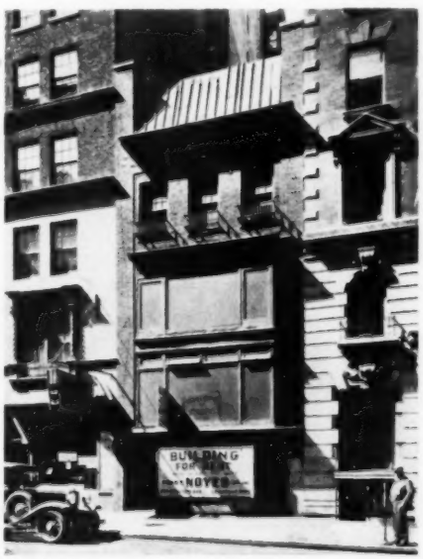
FIRST FLOOR: two-thirds of first floor raised to sidewalk level; two-thirds of second floor removed, the remainder, with new stairs from first floor, to serve as a mezzanine; new toilets on first floor and mezzanine; old stairs removed, new stairs from first to third floors.

SECOND FLOOR (formerly the third floor): re-plastered, new flooring, and new fire-retarding doors to stairs; new stairway and railing; new front window, painted and decorated.

THIRD FLOOR (studio apartment): entire floor replastered; new skylight; new fire-retarding doors to stairway, painted and decorated; new roofing over all.

EXTERIOR: front of building chipped and stuccoed with stone joint marking; store front design carried out in black Belgian marble; new show windows are framed with Kalamein moldings.

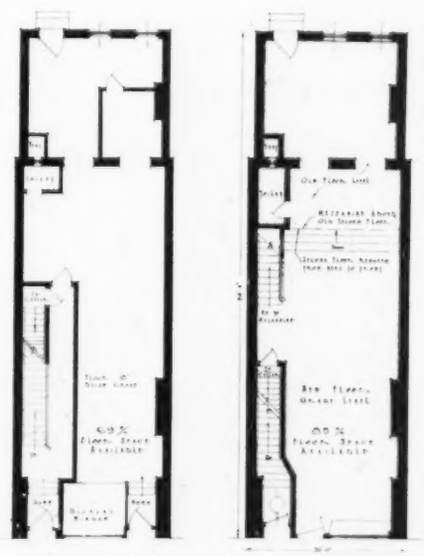
Rear yard was leveled off and concreted for a garden type restaurant.



Wurts Bros.
BEFORE ALTERATION

130 WEST 45TH STREET, NEW YORK CITY

FRANK A. ROOKE
ARCHITECT



BEFORE AND AFTER ALTERATION—AVAILABLE FLOOR SPACE INCREASED FROM 69% TO 85%

Lincoln
SHOWROOM OF ETA, INC., FOR DISPLAY OF WOMEN'S DRESSES TO BUYERS

SHOWROOM OF ETA, INC.
ELEANOR LE MAIRE, INTERIOR ARCHITECT

MATERIALS USED:

FLOORING: black and white designed rubber tile. Shaped gray rug with white goat hair fringe used on top of rubber tile floor.

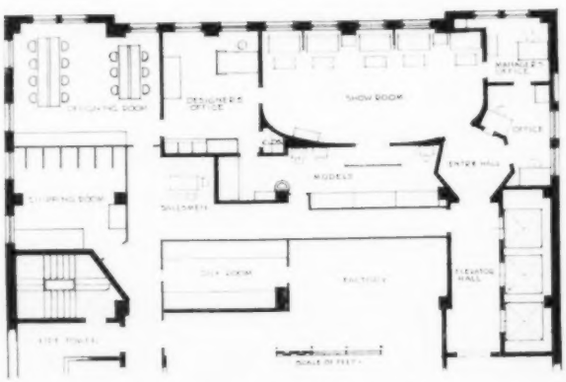
WALLS: plaster, painted. Half of room is white; other half is graphite color (the half of room used by buyers, etc., is in graphite or dark coloring; the half of room where models display gowns, etc., is in white.)

CEILING: part of the ceiling is done in silverleaf; other part is in white.

LIGHTING: cove trough light with glass rods.

FURNITURE: upholstered seat in vivid blue rep, white lacquer frames; tables, white and black lacquer; chairs, black lacquer frame with vivid blue webbing used for upholstery; folding screens, white leatherette; white cabinet with vermilion lining used to hold samples of material, etc.

Double slab door with glass rod and chrome handles leads to foyer. Opening with mirrored panel screen is used by models.



PLAN OF SHOWROOM, RELATED OFFICES AND FACTORY; ETA, INC., NEW YORK CITY

Lincoln
OFFICE OF DESIGNER, ETA, INC.
ELEANOR LE MAIRE, INTERIOR ARCHITECT

Richard Garrison

SHOWROOM FOR LILLY DACHE, NEW YORK CITY
M. B. SANDERS, JR., ARCHITECT

Walls, pale yellow; tables with white leather tops, legs of aluminum; chairs of aluminum frame with beige upholstery or with white lacquer; ash gray rug; indirect lighting.

BEFORE AND AFTER VIEWS OF ENTRANCE LOBBY TO INSULITE COMPANY, MINNEAPOLIS, MINN.
CLARENCE B. NELSON, ARCHITECT

REMODELED HOUSE AT SHELTER ISLAND, NEW YORK

RODGERS AND POOR ARCHITECTS

Van Anda

THE STRUCTURAL FRAME OF THIS HOUSE WAS RETAINED. PORCHES WERE REMOVED AND A NEW TWO STORY PORCH ADDED. THE OUTLINE OF THE HOUSE WAS SIMPLIFIED BY REMOVING TOWER AND PROJECTING BAY WINDOWS

HOUSE BEFORE ALTERATION

Van Anda

HOUSE AT SHELTER ISLAND, NEW YORK, AFTER ALTERATION. RODGERS AND POOR, ARCHITECTS

AETNA LIFE INSURANCE COMPANY BUILDING AT HARTFORD, CONN.

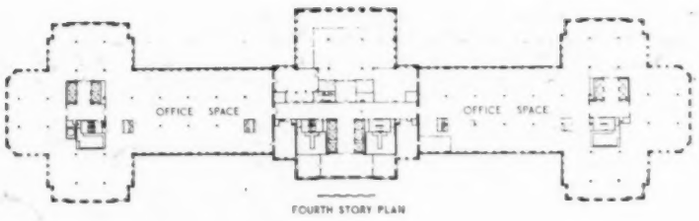
JAMES GAMBLE ROGERS, INC., ARCHITECTS

F. S. Lincoln

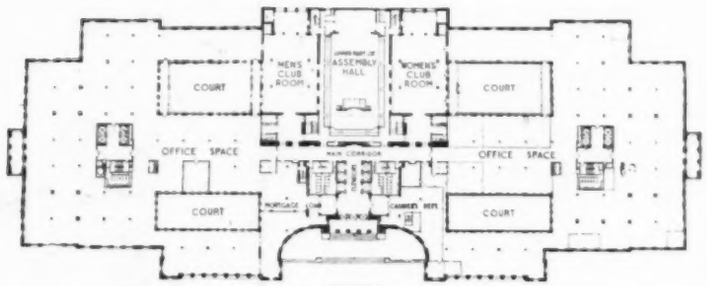
Entrance Façade

AETNA LIFE INSURANCE COMPANY BUILDING HARTFORD, CONN.

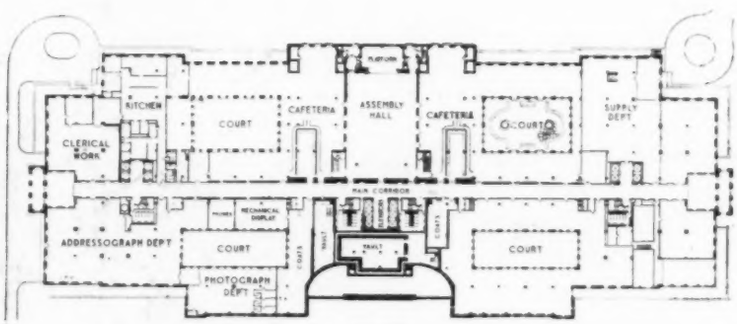
JAMES GAMBLE ROGERS, INC.
ARCHITECTS



FOURTH STORY PLAN



FIRST STORY PLAN



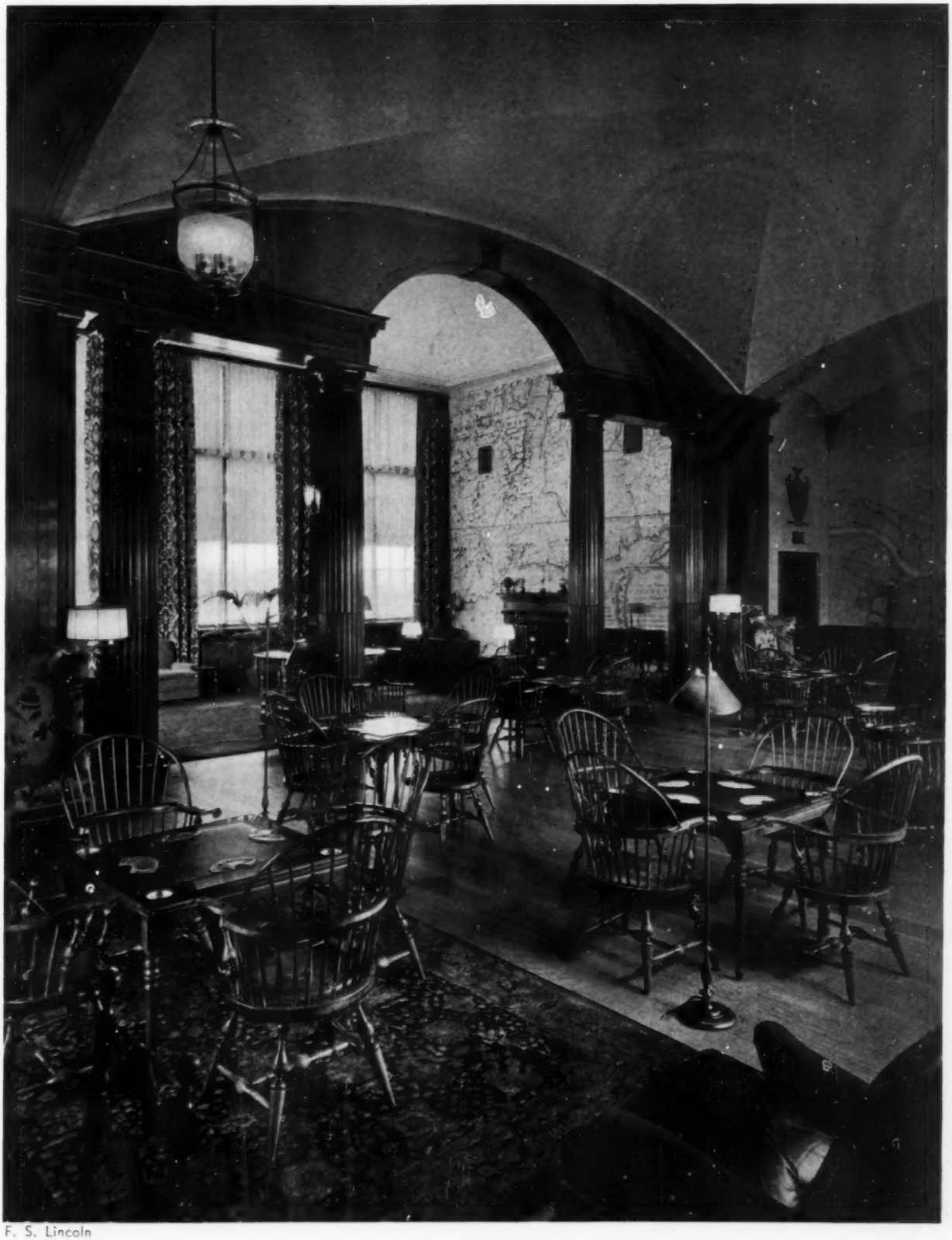
A STORY PLAN

The Colonial inspiration for the design of this particular building was the old State House still existing in Hartford. It is true that the problem could be handled more easily if the columns and trimmings were of wood instead of stone, but existing fire laws in our cities do not permit the use of wood for such purposes and so stone had to be used. A brick made in the vicinity in the same way that artisans have been making brick for the last one hundred years was selected—a real old Colonial brick. The stone is in harmony; the cold gray stone so often used has been avoided.

The plan is based on the principle that the building should have a main entrance on the first floor for visitors and the general conduct of business during the day, and also two ground-story entrances, one on each side, with elevators close to the door for the quick distribution of the workers. These two basement entrances are connected by a grand hallway, almost one-fifth of a mile in length, which permits easy distribution to all parts of the building. The elevators at the side doors may be closed except in the early mornings on entering and in the evenings on leaving and at the noon hour when the workers go to the lunchrooms and clubrooms.

The lunchrooms and lounges on the basement floor and on the first floor are furnished not in the institutional manner but as attractive dining rooms and clubrooms. There is also a grand auditorium between the clubrooms and the dining rooms, where meetings can be held and where games can be played. Off each dining room is a court in which there are well arranged walks and plants.

The officers are grouped together on the top floor with a large trustees' room where meetings can be held. This arrangement gives the best views and the best light to the rooms which are designed in simple and dignified Colonial style.



F. S. Lincoln

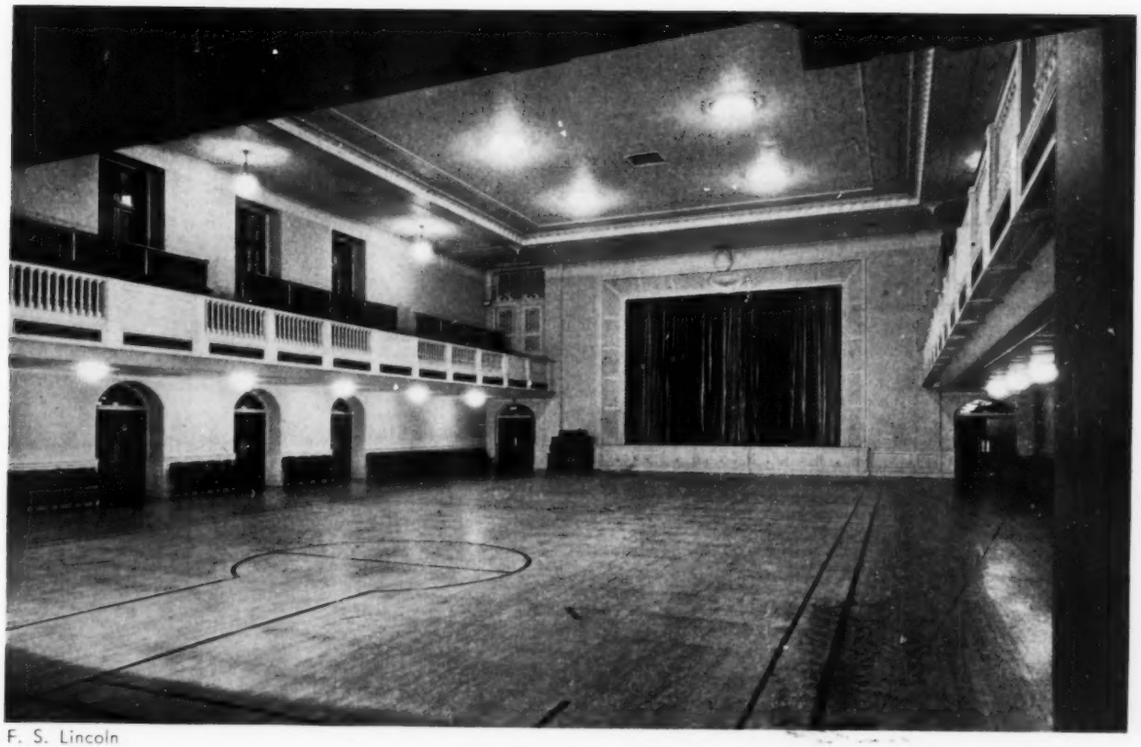
Recreation Room

AETNA LIFE INSURANCE COMPANY BUILDING AT HARTFORD, CONNECTICUT
JAMES GAMBLE ROGERS, INC., ARCHITECTS

F. S. Lincoln

Roof Terrace

AETNA LIFE INSURANCE COMPANY BUILDING AT HARTFORD, CONNECTICUT
JAMES GAMBLE ROGERS, INC., ARCHITECTS



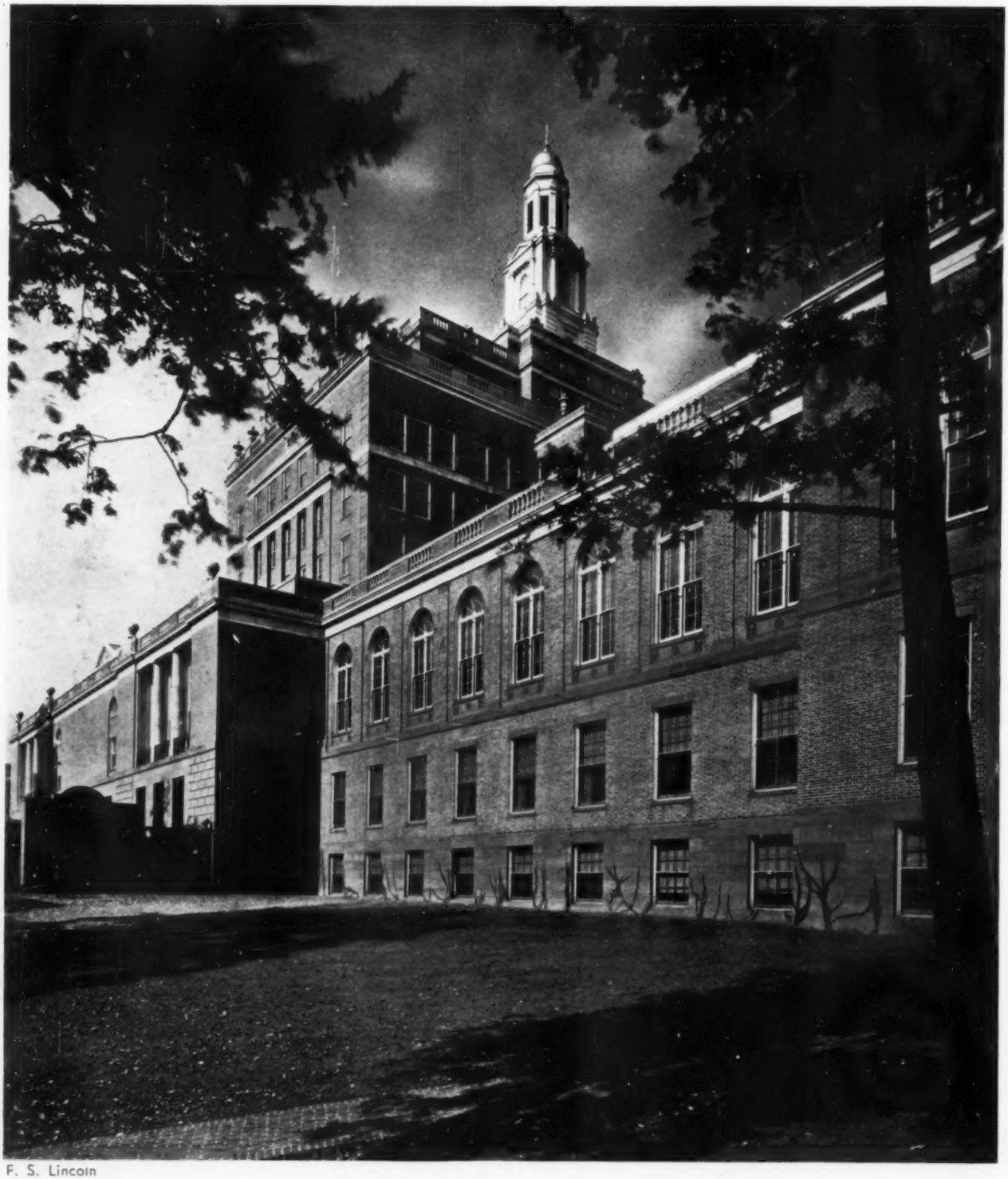
F. S. Lincoln

Gymnasium and Auditorium

F. S. Lincoln

A Private Dining Room

AETNA LIFE INSURANCE COMPANY BUILDING AT HARTFORD, CONNECTICUT
JAMES GAMBLE ROGERS, INC., ARCHITECTS



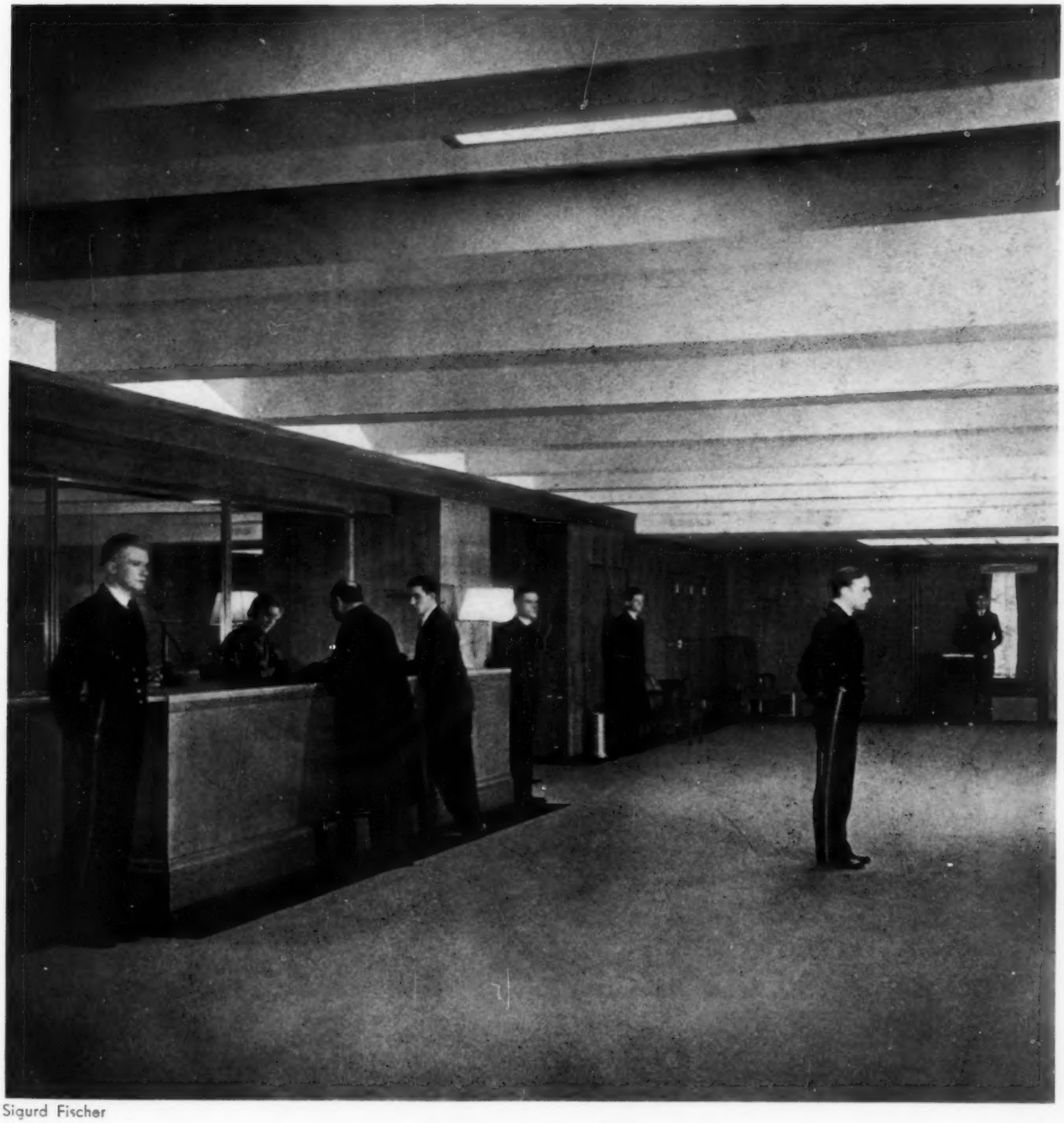
F. S. Lincoln

AETNA LIFE INSURANCE COMPANY BUILDING AT HARTFORD, CONNECTICUT
JAMES GAMBLE ROGERS, INC., ARCHITECTS

THE RADIO CITY BROADCASTING STUDIOS OF THE NATIONAL BROADCASTING COMPANY

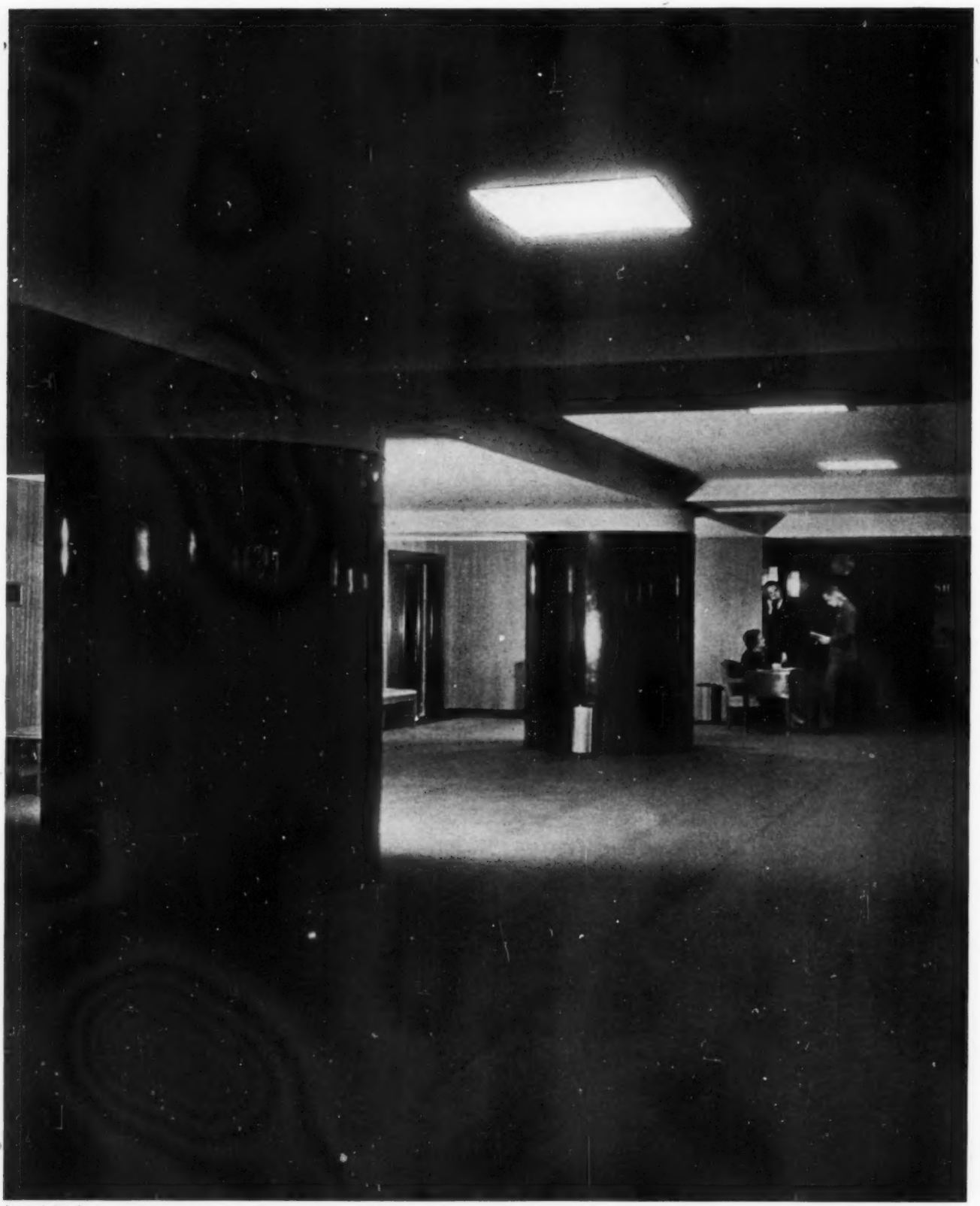
ROCKEFELLER CENTER, NEW YORK CITY

REINHARD AND HOFMEISTER; CORBETT, HARRISON AND MACMURRAY; HOOD AND FOUILHOUX, ARCHITECTS



Sigurd Fischer

Second-Floor Foyer for Program Personnel.



Sigurd Fischer

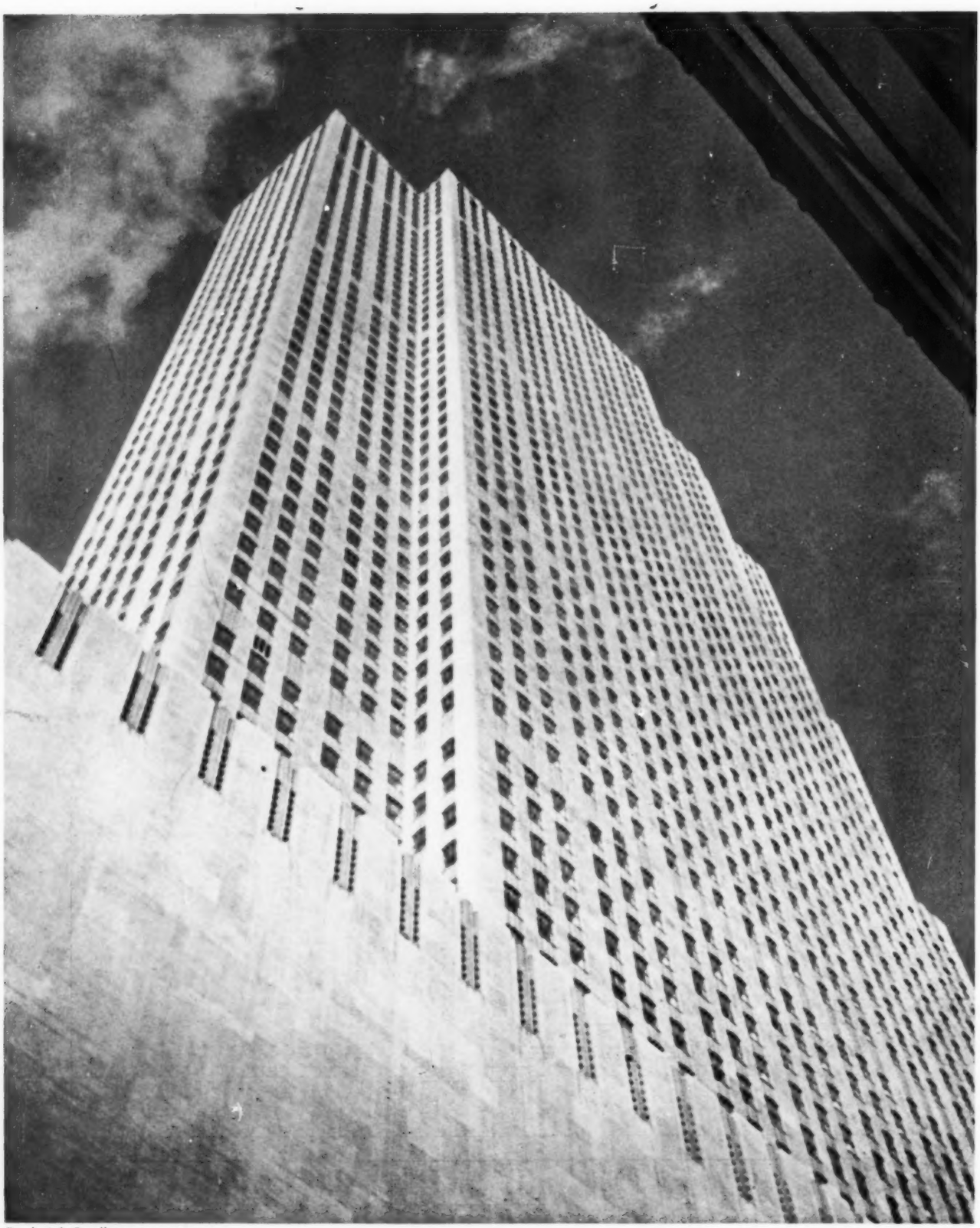
Eighth-Floor Foyer Serving Large Broadcasting Studio.

NATIONAL BROADCASTING STUDIOS, ROCKEFELLER CENTER, NEW YORK CITY
REINHARD AND HOFMEISTER; CORBETT, HARRISON AND MACMURRAY;
HOOD AND FOUILHOUX, ARCHITECTS

Sigurd Fischer

Public Foyer Displaying Glass-Inclosed Main Control Room.

NATIONAL BROADCASTING STUDIOS, ROCKEFELLER CENTER, NEW YORK CITY
REINHARD AND HOFMEISTER; CORBETT, HARRISON AND MACMURRAY;
HOOD AND FOUILHOUX, ARCHITECTS



Frederick Bradley

R.C.A. Building Façade. The N.B.C. Studios Are Housed in Windowless Section.

NATIONAL BROADCASTING STUDIOS, ROCKEFELLER CENTER, NEW YORK CITY
REINHARD AND HOFMEISTER; CORBETT, HARRISON AND MACMURRAY;
HOOD AND FOUILHOUX, ARCHITECTS

SOUND CONTROL AND AIR CONDITIONING

IN THE N.B.C. RADIO CITY BROADCASTING STUDIOS

By A. WARREN CANNEY, of the staff of Clyde R. Place,
Consulting Engineers for Rockefeller Center

Sound engineering is a newly developed science. Within the past decade it has grown into an extremely intricate subject because of the applications from the field of the electric circuit and, more recently, vacuum-tube electronics.

The electrical reproduction, transmission and measurement of sound has made necessary a large, highly specialized staff within the National Broadcasting Company, under the direction of O. B. Hanson, national radio authority, who was responsible for the design of the N.B.C. Radio City broadcasting studios. Mr. Hanson was required to not only incorporate the sum total of the experience of N.B.C. in the past but to anticipate future requirements in the face of the rapid growth of N.B.C. No detail known to present-day science has been overlooked toward a closer approach to perfection in the art of broadcasting.

The author of this article was in charge of the soundproofing of the air conditioning system and its design, as well as certain special soundproofing and thermal engineering problems.

SOUND CONTROL

Sound, in technical work, is objective, and is the disturbance or phenomenon in material media which becomes subjective only when it is perceived as a sensation of hearing. In engineering we speak of and control objective sound so that the subjective reaction of the hearers will be satisfactory.

Sound is caused by vibration. (The only possible condition of complete absence of sound would be the complete cessation of motion of everything in the world, from automobiles to atoms. There is no such thing as an absolutely soundproof room unless it be pumped to a complete vacuum.) As energy released from a vibrating source, the propagation of sound depends on the communication of these vibrations through any medium possessing inertia and elasticity, whether it be a loud speaker diaphragm, a tuning fork, a building partition, a steel column or merely atoms. A sound wave moves air particles and other media similarly. Unless obstructed, it radiates from the source, in air for example, in the form of a series of uniformly expanding spherical waves. This explains why the loudness-intensity is inversely proportional to the square of the distance from the source. The speed is given by the formula

$$V = \sqrt{\frac{KP}{p}}$$

where K—a thermodynamic constant: 1.4 for air.
P—pressure: 76 centimeters of mercury for air at sea level.
p—density: .0612 gram per cubic centimeter for air.
V—velocity: 1,125 feet per second for air.

This fundamental equation has been proved experimentally, and shows the velocity to be much greater in liquids and solids than in gases such as air.

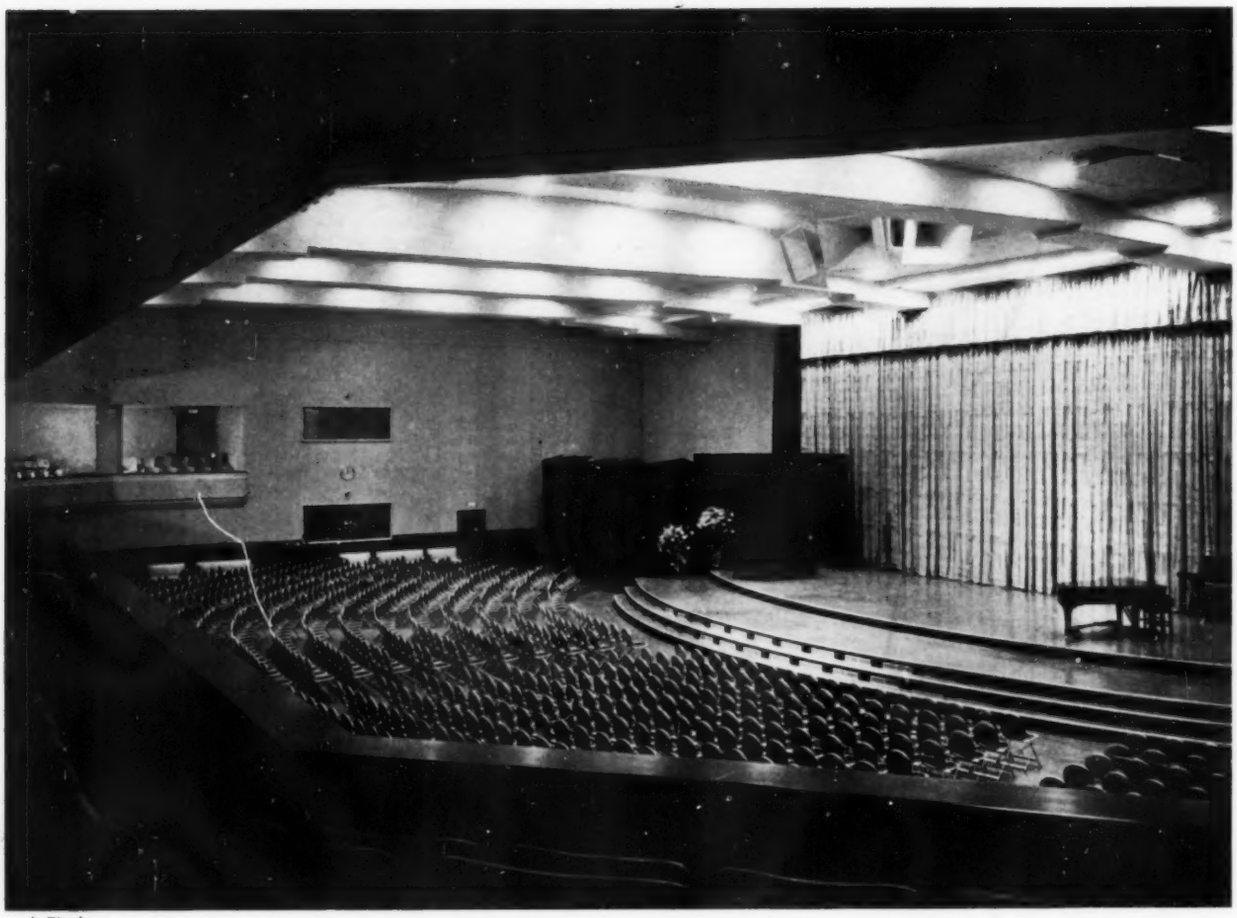
The velocity is an all-important factor as it determines, in part, how long sounds will take to "die out," that is, to diminish to inaudibility. Note, too, that the meteorological properties of air influence velocity according to barometric pressure and temperature. In psychrometry, relative humidity exerts influence on both speed and air absorption.

When something vibrates, say, at 512 complete back-and-forth cycles per second, what happens? Within one second 512 pushes are exerted against the air, as for example by a loud speaker diaphragm. The air is actually compressed 512 times, the first compression having traveled away radially 1,125 feet during the first second. An imaginary section through a photographic "still" would show

$$512 \text{ annular rings, each } \frac{1125}{512} = 2.2 \text{ feet apart,}$$

that is, with a wave length of 2.2 feet. Between these rings of compression (called condensations) there would be 512 midway regions of greatest rarefaction, where the air pressure would be below the barometric pressure of the air by an amount equal to the pressure of the condensations above it. The number of cycles determines what is musically called pitch, and we subjectively identify the pitch of 512 cycles with the musical scale tone "middle C." The regions of minimum pressure are situated exactly halfway between the regions of maximum pressure, or one wavelength apart.

This conception of the transfer of alternating pressures and rarefactions is vital to the comprehension of sound wave disturbance in any media.



Sigurd Fischer

The Largest Studio in the World — Three Stories High.

NATIONAL BROADCASTING STUDIOS, ROCKEFELLER CENTER, NEW YORK CITY
REINHARD AND HOFMEISTER; CORBETT, HARRISON AND MACMURRAY;
HOOD AND FOUILHOUX, ARCHITECTS

The particles sway as each vibrational push transfers its impulse from particle to particle. Frequency mostly, and velocity somewhat, determine wave length and consequently the pitch. The amplitude, together with frequency, is an index of the intensity or subjective loudness. The total energy E of a vibrating mass M, generating a pure tone with amplitude A and frequency N is given by $E = 2M\pi^2(AN)^2$. Note particularly that the total energy (power) is proportional to the square of the amplitude (pressure or, in electrical work, voltage). In a receiver, only a small part is converted and radiated into effective objective sound. The inefficiency represents dissipated energy, usually in the form of lost heat. A vibrating string may vibrate through a large amplitude, but its reinforcement is obtainable by a sounding board, usually in musical instruments, which have more mass than the string but vibrate through much smaller amplitudes than the string.

People can hear amplitudes, on the average, between sound pressure changes in the air above the usual barometric pressure, of from .00000000855 to .029 pounds per square inch. At less pressure change than the first figure, people cannot hear sound; above the upper limit the sound is sensed as a pain productive of anger. The frequency limits of hearing are within about 20 to 15,000 cycles per second. This sensible hearing range includes about 10 octaves and the amplitude or air particle displacement in the region of inaudibility is only .000000001 inch!

Complexity of Sound Investigation

The all-important elemental consideration of quality is doubtless the greatest complication. Quality is created by superimposed, regularly-recurring wave-forms due to overtones which, in accordance with the laws of physical resonance, are variations in the main pressure wave. This main pressure wave is the fundamental frequency, and is the lowest tone in the sound. The number and prominence of these overtones constitute the basic complexity of a musical sound.

The manner of reinforcement, as by a piano sounding-board, produces further modifications ef-

Sigurd Fischer

Ed Wynn Broadcasting in the Large Studio

NATIONAL BROADCASTING STUDIOS, ROCKEFELLER CENTER, NEW YORK CITY
REINHARD AND HOFMEISTER; CORBETT, HARRISON AND MACMURRAY;
HOOD AND FOUILHOUX, ARCHITECTS

fecting timbre. If the superimposed waves are not of regular recurrence with respect to the fundamental, the sound is sensed as a noise. The Radio City Studios have been designed to preserve with fidelity *all* of the frequency components which are used in speech and music. All must be of sufficient intensity to enable the ear to analyze these complex vibrations into their simple harmonic components in perfect identity with the vibrating source. To illustrate: put your foot on the loud pedal of a piano, and sing a note into the strings for a few seconds; the string whose normal fundamental vibration is the counterpart of the note you sang will sound loudest. But sounds arise from many other strings too! Each of these strings produces its overtone of that frequency. This crudely illustrates one process of the mechanism of hearing. The response of the ear to a symphony at any instant is obviously much more multifarious than this.

If extraneous sounds are rather loud, the sounds one wishes to hear must be louder, unless their pitch be very different. In a studio in Radio City, for example, one can easily discern a distant whisper, or hear one's heart beat. Some one else talking normally would prevent you from hearing the whisper. This is called masking. Extraneous sounds must be reduced to a certain maximum intensity level to permit good hearing indoors. In broadcasting this level must be very, very quiet. The shape and composition of interior surfaces of the room establish, together with usage, the upper limit of permissible sound level.

If two sound waves of nearly the same pitch are sounded within a room, there will be regions of nearly complete annulment and easily discernible reinforcement. Throbs occur, noticeable sometimes in organ music. Normally these factors are to be avoided or controlled within well defined limits.

Owing to its wave length, sound "bends" and expands after passing through an opening such as a crack under a door. In this respect sound doesn't behave like light, which has very minute wave lengths. The thinnest razor-like slit is required to diffract light. Not so for sound, which has wave lengths from 60 down to .065 feet. Auditorium

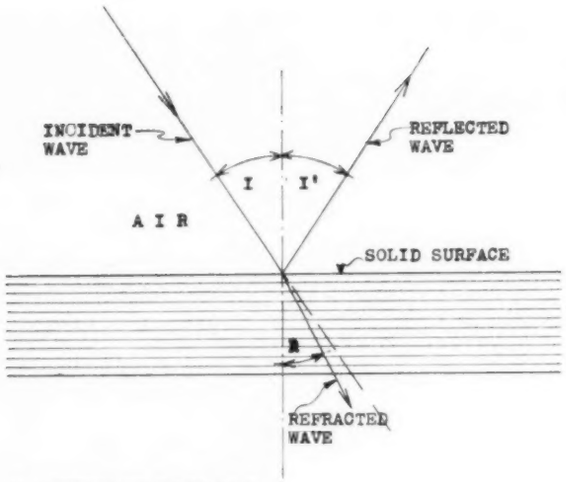


Figure 1—This diagram illustrates the reflection and refraction of sound.

designers have sometimes assumed that sound is diffracted after reflection much as light, which is usually not the case. Sound follows the simple laws of reflection and refraction as indicated in Figure 1, but diffracts with the spreading effect of the spherical wave forms.

Most diffraction occurs where the boundary surface is flat and very large. In any case it is dependent on the size and shape of the hole, edge, or surface and the frequency-band involved. With complex interiors sound engineers make models and by light or by water waves analyze the "wave-front" distribution, so that modifications of the interior profiles may be made, if necessary. By following the geometrical progression of the wave front interiors may be modified to control diffraction.

This brings us to one of the most important considerations in acoustics—the reverberation time-period of the room under consideration. This depends, broadly, on the number of reflections combined with the amount of energy absorbed, and may be described as the length of time a sound of given initial intensity, frequency distribution and location in the room "decays" to a level of inaudibility.

Energy Content and Sound Level

Note that in the energy formula, the intensity E, which is the technical term for loudness or energy content in the sound wave, is proportional to the square of either the velocity or displacement amplitude. This means that if a vibrating object vibrates through greater distance, or faster through the same displacement distance (amplitude), or both, the sound will be subjectively louder and objectively greater in intensity.

A microphone is an instrument which varies the voltage of an impressed electric current in a wire proportional to the rate of change of sound energy in the air at each instant. The condenser microphone operates on a displacement principle. The Radio City studios of N.B.C. use a new type of microphone which effects this with greater fidelity, but is based on the rate of change of velocity of the sound waves.

Based on pressure changes, the intensity of sound

$$I = \frac{P}{10 \times L \times D} = \text{microwatts per square centimeter,}$$

where P = dynes per square centimeter of pressure.
L = centimeters per second (velocity).
D = density of the material in which the sound is being propagated, such as air, in grams per cubic centimeter.

If everybody in the United States talked normally at once, the total resulting speech energy output in the air would only be some 8 horsepower! From this an idea of the extremely minute amount of energy involved in sound can be obtained. To change the voice of only one person to a variable electric current, to amplify these minute energy quantities and propagate them without interruption as an aerial radio wave with sufficient energy for every "listener-in" in the territory served by the radio transmitting station—with perfect fidelity—is the amazing business of the broadcasting company.

The relation between the intensity-pressure of a sound wave and the loudness heard is logarithmic. Most sensory stimuli of the body follow this law closely. In an effort to obtain a mathematical relation between the loudness of sounds as we hear them, a unit of intensity-level called the decibel is widely used, which defines the number of sensation units between the energy of two sounds which are to be compared. In other words, a decibel is equal to a change in hearing loudness which the average ear can reasonably well distinguish. The original comparison was written by telephone engineers as follows:

$$\text{Sound Level Difference} = \text{S.L.D.} = \text{Bels} = \log_{10} \frac{P^2}{P^1}$$

where P^2 is the sound having a greater pressure than P^1. P is conveniently computed in units of dynes per square centimeter. Ten times this numerical ratio resulted in the pressure differences which could be reasonably well distinguished by the average listener. The numerical result was therefore assigned the name of decibels, wherein unity equals one decibel.

This is written $DB_p = 10 \log_{10} \frac{P^2}{P^1}$—when P is measured in pressure units. Let 10,000 and 100 be the pressures of two sounds then $10 \log_{10} \frac{10{,}000}{100} =$

$10 \times \frac{4}{2} = 10 \times 2 = 20$ DB. One hundred times as

much energy as 100 dynes per square centimeter seems only twice as loud. But intensity (power) is proportional to the square of the pressure.

$$\text{Hence DBs} = 10 \log \left(\frac{P^2}{P^1}\right)^2 = 20 \log_{10}\left(\frac{I^2}{I^1}\right)$$

when I is measured in power units such as microwatts, or ergs per square centimeter, per second DBs are merely convenient measuring units associated with the logarithmic characteristic of hearing.

Inasmuch as most modern measurements are made electrically and in power, DBs are DBs whether the sound energy is measured in the air, or equivalent electrical energy in an electric circuit, or whether it is what you hear, or energy in a steel column picked up by a passing truck, because DBs are quantitative *under specified conditions*. Unless the condition of arbitrary zero be specified or understood DBs are meaningless. A sound which is louder than another is said to be of higher energy level. Thus DBs are a numerical expression of difference of loudness. Above the level of the threshold of inaudibility DBs are commonly used as an index of sound level.

The amount of sound energy removed by something such as a partition is called attenuation. This varies, for a given inclosed object, with both frequency and intensity of the original sound. The attenuation is, then, merely the sound level reduction under certain stated conditions and may be numerically stated by the difference of the DB levels on the two sides of the object above threshold as zero level.

Figure 2 shows the DB level above the threshold of audibility as zero DB for places having various sound intensities.

With the improvement of electrical broadcast facilities, it was essential for N.B.C. to control the sounds in regard to their true undistorted qualities before their impingement on the microphone diaphragm, which means "handling" the sound in the studio proper. In Radio City the whole design has been based on a frequency band encompassing frequencies practically throughout the audible range which means from 40 to 15,000 cycles. This has meant the examination and control of the whole phenomenon in a radio broadcasting studio, throughout this extended range, an attainment of results not hitherto attempted in broadcasting work.

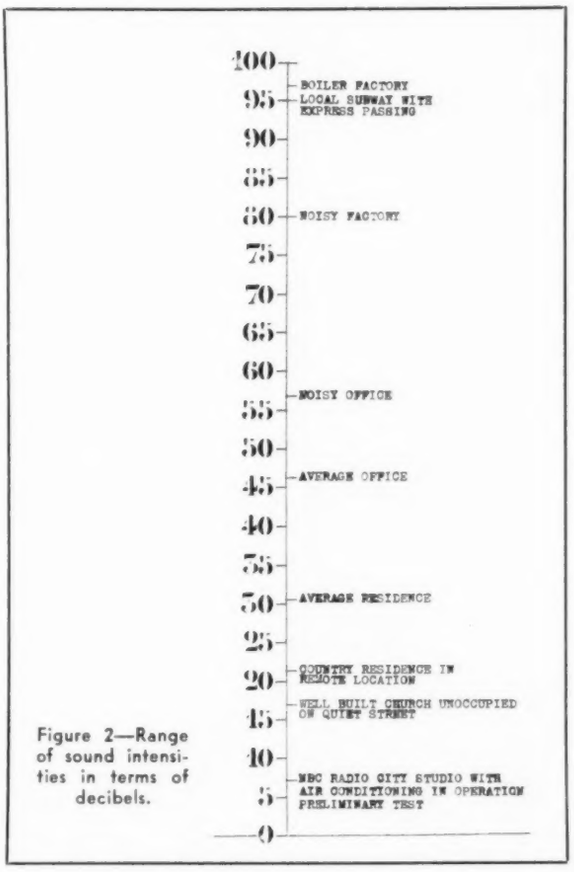


Figure 2—Range of sound intensities in terms of decibels.

Reverberation and Sound Absorption

In general, hard dense surfaces, such as metals, reflect sound much more than the surfaces of materials which are microscopically porous, these latter usually being light in weight and sometimes flimsy. It is an inherent property of most materials to absorb different amounts of sound at different frequencies. The more totally absorptive a given room is, the sooner will a sound of given initial intensity decay to inaudibility. Under specific conditions this time period of decay is termed the reverberation period of the room, and is based on the mean total distance of all reflections of a sound having a specific initial intensity.

Reverberation is one of the most important characteristics of a room in studio sound engineering. Reverberation formulas are not rigidly applicable and are empirical. To provide studios of proper and sufficiently variable reverberation periods for any type of program production was one of the problems which confronted the Radio City engineers.

An opening in an outside wall one foot on a side gives a sound absorption coefficient of unity—the maximum—for none of the sound in the form of a plane wave is reflected by such an opening. Unfortunately the absorption of a material has been a rather elusive figure to measure, but sufficient agreement for commercial work is usually obtained. Moreover, the frequency range tested is usually only within 128 to 4,096 cycles, and frequently the absorption at 512 cycles is the only test point, all of which was inadequate for the requirements of the Radio City studios. In addition, the maximum absorption of most materials lies within this range. In Radio City a practically flat absorption curve from 40 to 15,000 cycles was the necessary requirement.

When a sound wave impinges on any material its total energy is distributed by reflection (R), absorption (A), and transmission (T) in the in-

stance where R and A is less than the total. The mechanism of absorption converts the energy to heat. The less reverberant a room, the more absorption there must be, and total wall, floor and ceiling absorption equals the summation of the product of the square feet of each kind of surface times its absorption coefficient. Thus, where the area is limited, sufficient absorption must be obtained in the material. The more the absorption the less the transmission, so that while the amount of absorption is the prime consideration establishing acoustical treatment, the absorptive material also helps cut down the amount of energy transmitted, that is, increases the attenuation of the total construction.

The importance of reverberation can be appreciated by considering that if the reverberation time is excessive, sounds will overlap due to prolongation, and the result will be muddled by masking and superimposition. Slight overlap in organ and symphony work is not altogether objectionable in the concert hall, however, where the listener is where the program originates. On the other hand, in radio work any type of program may originate in a studio, and to whatever reverberation period occurs in the studio, there must be added the reverberation time of the room in which the listener's radio loud speaker is located.

The old and universally used scheme of meeting these problems was to vary the reverberation period with the amount of sound-absorbing drapes exposed, the amount and kind of carpeting, the size of the audience in the studio and perhaps hinged panels containing absorptive materials on one side, or by any combination of these.

Studio Requirements

The exacting standards set by N.B.C. for the new studios ruled out these uncertain methods in large measure. The combined location of the absorbing and relatively nonabsorbing surfaces effect the reverberation period and, of tantamount importance, the uniformity pattern of sound distribution in the studio. Multiple reflection and partially dead spots are inherent without highly scientific design, it was recognized.

Absorption in many of the Radio City studios is therefore variable by means of remotely controlled panels which slide in and out of pockets along the wall. By the touch and release of a button by the control engineer, the reverberation may be varied. Different reverberation periods in the same studio are demanded by a band and a string quartet for example.

Program technique demands adjustment of reverberation, location of microphones and distribution of artists to provide the uniform blending so that the microphone receives all the sounds in their desired relative proportions for the reproduction desired. Program technique is a science in itself, but demands uniformity of sound distribution. This resolves itself largely in what to do in studio design to eliminate conditions which should not occur

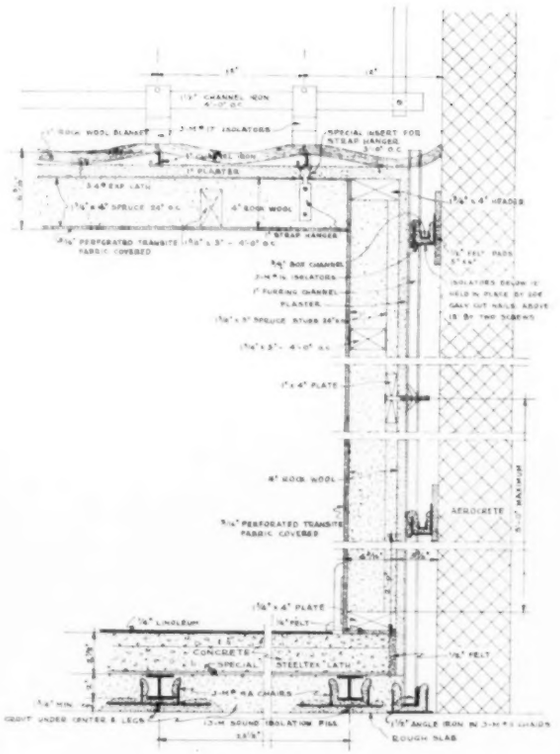


Figure 3—Construction detail of studio soundproofing systems.

in the space pattern of sound distribution. There are, of course, studios of varying sizes suited to both number of performers and total sound intensities.

Microphones may be located anywhere in studios which are individually of fixed size. Microphones, of course, respond as would a person with one ear in use in place of two. Furthermore, in normal usage, microphone electric circuits are much more sensitive than the ear, because they pick up sounds which are of inaudible intensity in direct listening. For this reason the studios must have a residual sound level which is extremely low, of the order of only a few DBs above minimum threshhold, and which must be maintained even with the air conditioning system in operation, with elevated train rumbles in the ground around footings of the building, elevators, plumbing pipes connected to noise-generating fixtures, with electrical conduits which are apt to be set in vibration or pick up sound due to any one of a hundred potential disturbances. and in spite of sounds originating in the rooms surrounding each studio. These matters resolve themselves into a problem of sound isolation and involve considerations in addition to the acoustical requirements within each studio.

Acoustical Features of the N.B.C. Radio City Studios

Before examining the question of isolation, a few points regarding the acoustics in the Radio City studios will be explained.

Many ceilings and walls have a V-surface profile as an important influence in obtaining distribution uniformity. Considerable study and calculation underlies the design of these ceilings.

The multiple-glass partitions are sloped to avoid multiple reflection and localized reinforcement. The lights are flush with the ceiling to avoid interference patterns. These light fixtures are resonance-proofed and sound-transmission-proofed. The proportions of the studios follow ratios of length, width and height first developed and experimentally verified by Mr. O. B. Hanson as the best proportions for broadcast work. The observation windows of double and triple glass range from 5/8" to 3/8" thick and are set to provide maximum necessary attenuation with the prevention of resonance. Floors are quietized with a linoleum surface material.

Many other details which are duplicated in each studio revolve around the technical requirements as the prime consideration. The logical basis for this is that the broadcasting studio is fundamentally a technical workshop in the production of sound. *Fabric, the interior surface variable medium for the architect plus the construction developed as indicated in Figure 3, conformed to both primary objectives—varied interiors which would be an architectural medium to enhance the poise and complacency of those who broadcast, yet fulfill the technical requirements.*

Sigurd Fischer

Figure 4—View of television control room (see plan below).

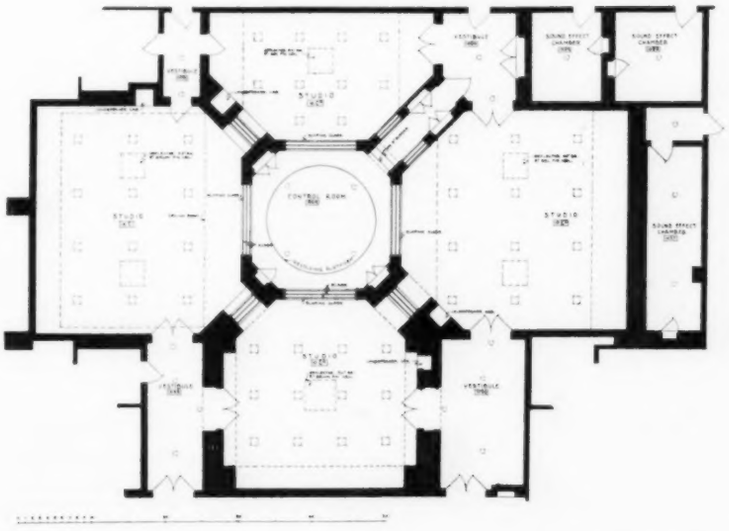


Figure 5—Plan of future television studios on ninth floor of R.C.A. Building.

SOUND CONTROL REQUIREMENTS

We may now clearly subdivide the basic requirements:

1. Acoustical treatment for the control of sound originating in the studio (interior treatment).
2. Provision for a maximum residual sound level by control of sound transmission of sounds originating outside the studio.

These two classifications of control apply to practically every problem affecting architecture.

Construction Details

The Acoustical Construction Corporation, a subsidiary of Johns-Manville, were contractors for the soundproofing. The labeling of this construction in Figure 3 is self-explanatory. The perforated transite was selected because it is a thin, space-saving, strong, nonwarping material for receiving the fabric. The perforations, of course, enable the sound energy to be absorbed by the mineral fiber.

The transite does not reduce the absorption efficiency of the rock wool at all appreciably. The special clips employ hair felt, and their use is to keep diaphragm action out of the special acoustical T.C. wall. The T.C. wall may be a structural wall or a partition; in any case its use is an integral part of the construction.

Figure 5 shows the future television studios on the ninth floor of the N.B.C. quarters of the R.C.A. Building. Figure 4 is an unusual photograph of the 4-sided television control room shown in the center of the plan of Fig. 5. Guides explain this to guests as a part of the tour through the studios arranged for the public.

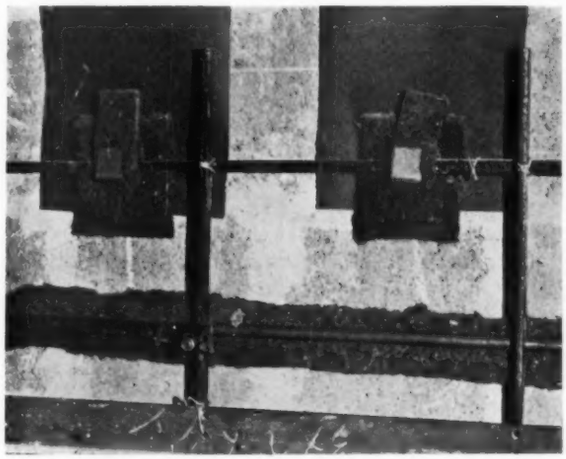


Figure 6—Detail view of clips with hair felt as soundproofed point contact construction.

Prevention of Sound Transmission

It should be emphasized that this composite construction prevents transmission by a combination of the following principles in obtaining two-way attenuation:

1. Absorption necessarily provided for item (1) above.

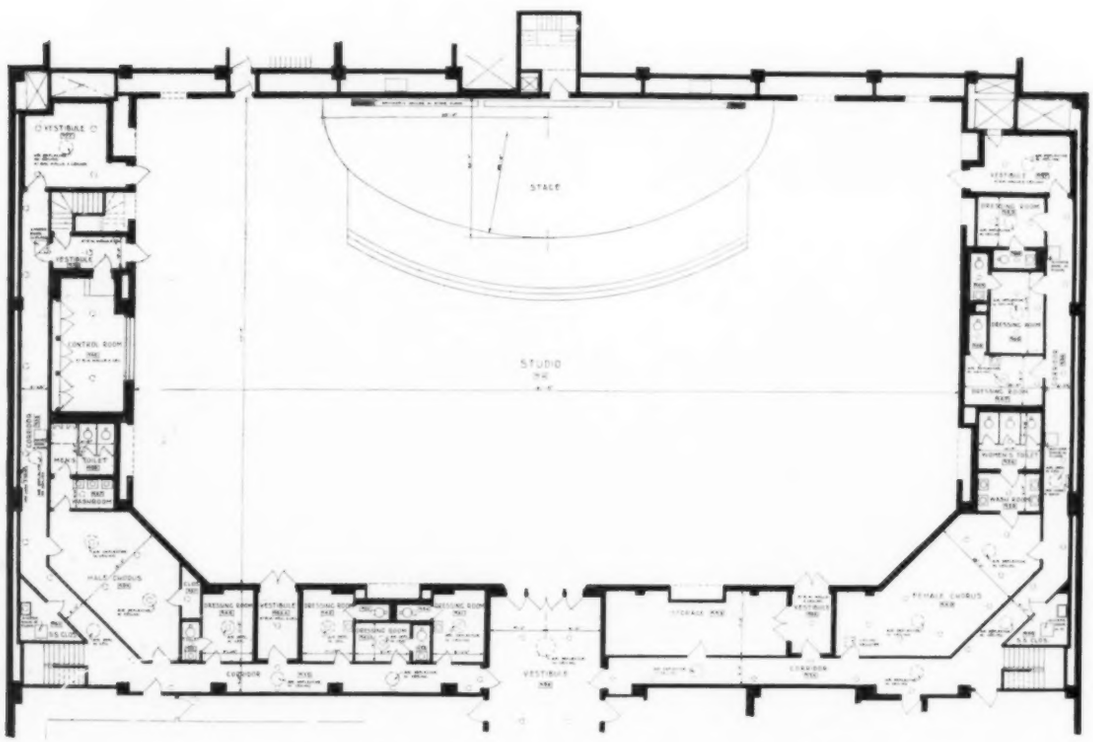


Figure 7—Plan of three-story studio illustrated on pages 78 and 79.

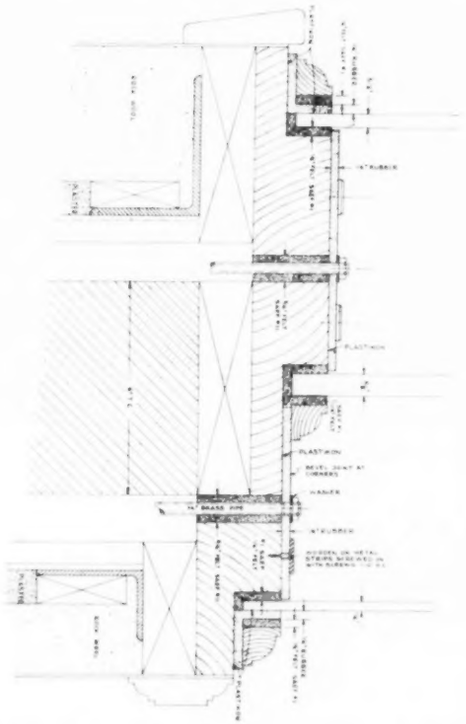


Figure 8—Detail of system of window isolation developed by author in collaboration with N.B.C.

2. Attenuation provided by reduction of passage of sound energy through materials of different density.
3. Prevention of diaphragm action.
4. Prevention of sound energy in the building from reaching floating construction.
5. Attenuation by provision of mass damping.

This construction, in the instance of two adjacent studios is good for about 100 DB, that is, a sound of subway train intensity in one would be inaudible in the other.

The use of the construction indicated in Figure 3 employs, therefore, a system of "point contact" in the form of wall isolators, floor pads supporting wood sleepers, and ceiling clips, each utilizing hair felt for point contact as an aid to damping out sound. Fig. 6 illustrates the clips and also shows an isolated pipe. Their spacing is related to both the isolating efficiency, as related to sound energy levels involved on both sides, and the total weight loading, both static minimum and local maximum. This involves light fixtures in the ceiling, and people and pianos on the floor, for examples. The net effect of this point isolation is to create a room within a structural room, referred to as "floating" construction.

Figure 7 shows a plan of the three-story studio illustrated on pages 78 and 79. All spaces shown on this plan with walls of heavy poché show where floating construction is used.

Sound Control Details

The attention of the reader is called to the typical vestibules in Fig. 7 using double doors creating sound-locks surrounding studios. The doors have heavy checks and are of extremely rigid mounting. A change in section plus a special double rubber line-contact provides isolation.

Figure 8 shows a detail of the method of window isolation developed by the author in collaboration with N.B.C. Out of this construction method an original means of keeping the interior surfaces clean was developed while equalizing barometric pressure on both sides of the panes.

Soundproofed Air Conditioning System

The most potentially dangerous continuous generator of sound above the maximum acceptable residual level is the air conditioning system. Extensive air conditioning researches were conducted at the Times Square studio of N.B.C. in order to obtain data extending over the full frequency range which the Radio City Studios were designed to meet. The following problems were due to air conditioning and their acceptable attenuation or elimination was essential:

1. Any sound originating from any source anywhere in the studio section and getting into ducts or taking any detrimental path whatsoever through ductwork.
2. Mechanical equipment sounds through ducts.
3. The flow of air from either friction or turbulence.
4. The flow of water and pump sounds in pipes.
5. Refrigeration compressors, both air borne and structural transmission.
6. Structural transmission from air handling apparatus.
7. Steam air heaters.

The Carrier Engineering Corporation's tubular system for sound absorption within air ducts was

Figure 9 typically illustrates the air conditioning supply ductwork at a studio ceiling. The straightaway sections receive the internal sound absorbers in the duct.

Figure 10 shows the canvas connection indicated in the air conditioning outlet of Figure 9 which provides isolation between the hung ceiling and the sheet metal duct. The wood ground will support the plaque which distributes air from the outlet.

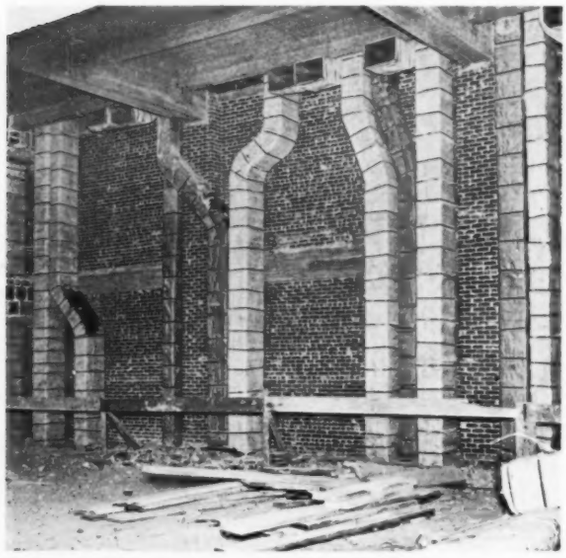


Figure 11 illustrates some of the vertical air conditioning ducts wrapped with soundproofing material on the outside. Similar ducts completely fill the duct shaft which runs along the entire west wall of the three-story studio, which may be observed by reference to Figure 7.

employed. It has been successfully adequate.

At no time does the air at any point within any acoustically treated room such as a studio vary more than .004 pound per cubic foot. Moreover, there are no air stratifications which would disturb the uniform distribution of sound waves in the studios.

Acceptable velocities, stream-lining, channeling and absorption are a few of the elemental considerations in quietizing the air conditioning system. The handling of the air to meet specific sound level requirements is an intricate study in itself.

Isolation of Mechanical Work

All electric conduits have been sound-isolated where they penetrate studio structural walls, being discontinuous in terms of sound isolation, and are also supported so as to be resonance-proof. This applies to all plumbing. Elevators and steam risers have likewise received due attention from a sound isolation standpoint.

Isolation of Extraneous Sounds

The studio section is also isolated from street, airplane, ground and other outside extraneous noise. There are windows only on the two office levels in the studio section of the R.C.A. Building for this reason. Control rooms and observation rooms, both public and those especially provided for the clients of N.B.C. are soundproofed against two-way disturbance and are acoustically treated, mostly from a reverberation standpoint in consideration of program loud speakers.

THE N.B.C. RADIO CITY AIR CONDITIONING SYSTEM

In the development of broadcasting studio design, the N.B.C. requirements for lower sound levels and for air conditioning have interacted in such a way that both have demanded more refined practice as new studios were built, until now the nature of the construction makes air conditioning an absolute necessity. This is because the construction is thermally equivalent to about 10 inches of cork so that whatever heat is emitted to the air can not possibly escape by natural means. The heat emission is so great from the occupants and the lights that straight ventilation would create a veritable gale to keep the studio temperatures down to 100 degrees when it is hot out-of-doors in summer. Moreover, the duct sizes for such extraordinary air volumes would be prohibitively large.

The experiences of N.B.C. have demonstrated that performers are not at their best unless they are perfectly comfortable. Thus a "thermos bottle" construction plus provision of complete human comfort demanded air conditioning.

The importance of the air conditioning system led to an expenditure of over a million dollars for this one mechanical service. This extraordinary expense was partly caused by the following special requirements:

1. Individual studio automatic remote control.
2. Subdivision of the 9 occupied floors into over 300 air conditioned rooms.
3. Sound control.
4. Heavy duty service of 18 hours every day in the year, and breakdown protection.
5. Nearly 100 automatically individually controlled spaces in addition to studio controls.
6. Narrow control-limit requirements.
7. Centralization of equipment for quick repair.

Inasmuch as the only windows are on the second and fifth floors, the N.B.C. space probably represents the most efficient cold storage construction in the world. The inability of heat to escape from the studio section demands cooling even in the dead of winter. The outdoor atmospheric conditions affect only the refrigeration load and the heating of the offices.

Let us examine how this air conditioning system functions.

The human body dissipates in all of the following ways the heat it generates:

1. Convection of cooler air layer adjacent to skin.
2. Evaporation of skin surface moisture, whether visible or invisible.
3. Radiation to surrounding boundaries at a temperature lower than the body, such as clothes and walls.
4. Exhaled breath.
5. Heat in moisture of exhaled breath.

The body's automatic temperature control is contained mostly in the variation in the amount of surface skin moisture to be evaporated. This normally varies in an adult between .0017 to .005 pound per minute. On evaporation this moisture

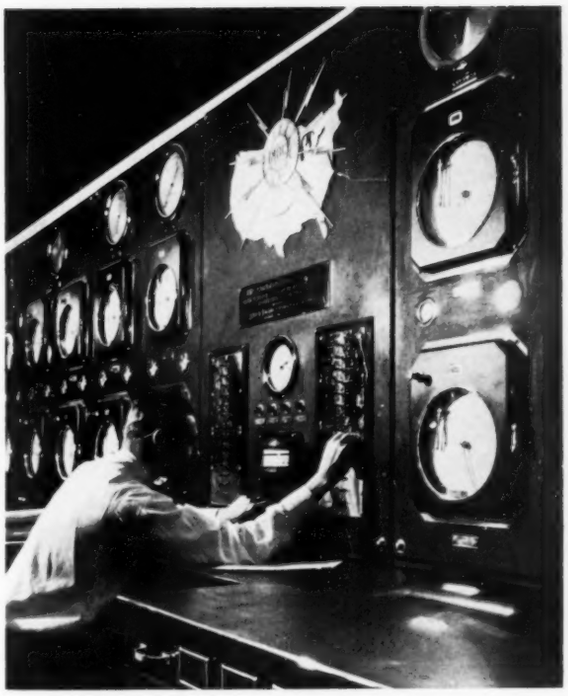
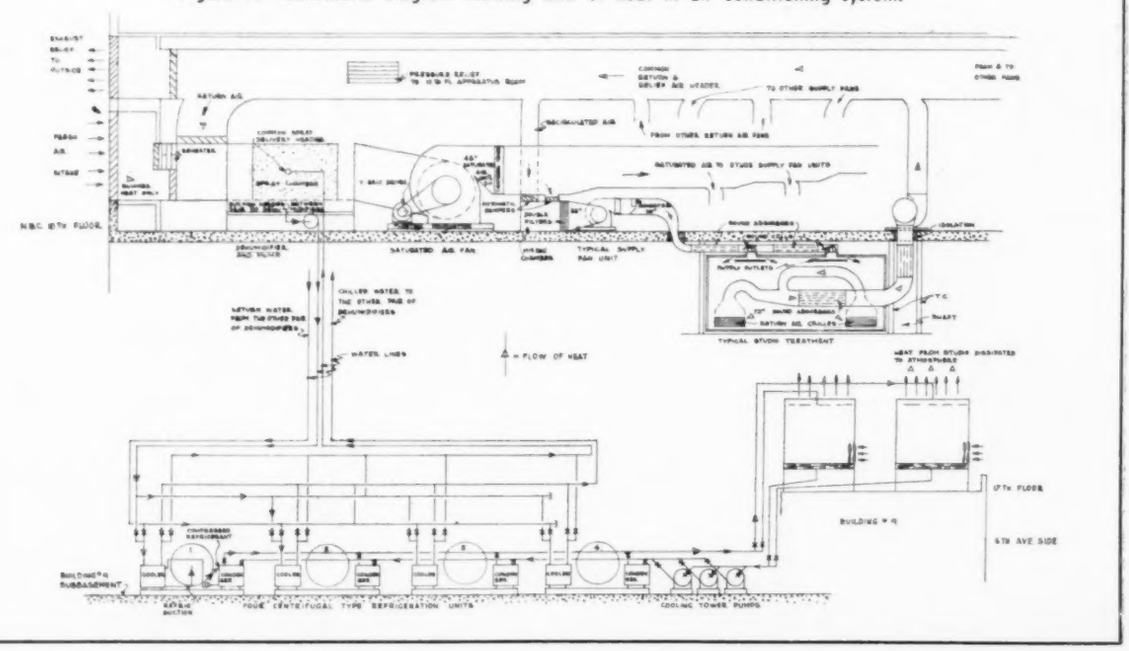


Figure 12—Close-up of remote central control board. View shows author operating the system for remotely obtaining temperatures in 60 important rooms.

tends to increase the water vapor content and hence the relative humidity of the air, and the rate of evaporation is dependent on the existing atmospheric relative humidity and air circulation. Thus relative humidity control is as vital in air conditioning work as temperature control. As a matter of fact, in summer and most places where we feel oppressively hot, the relative humidity is excessive-

Figure 13—Schematic diagram showing flow of heat in air conditioning system.



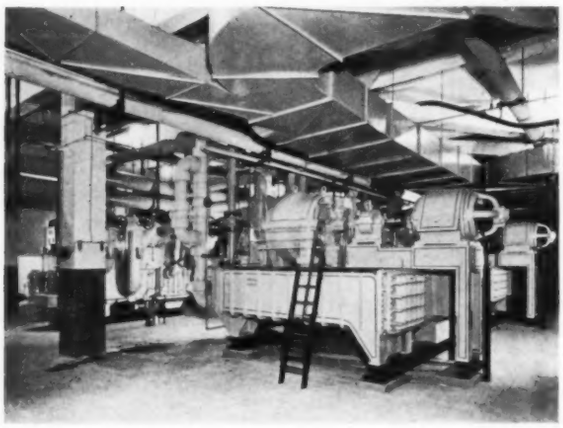


Figure 14—Refrigeration room.

ly high, and causes greater discomfort than the high temperatures of the air normally encountered. Relative humidity control, then, maintains the most desirable rate of evaporation of skin-surface moisture, the prime regulator of body temperature. No system for human comfort can, therefore, properly be labeled air conditioning without relative humidity as well as temperature control all year round, regardless of weather. In the studios, temperature is controlled automatically within plus or minus ½ of one degree of the control point, regardless of the number of occupants or their respective rates of emitting heat.

Figure 12 is a close-up of the remote central control board. Any condition desired in any studio may be attained quickly from this point. This illustration shows the author operating an electrical system for remotely obtaining the temperatures in sixty important miscellaneous rooms other than studios.

Figure 13 is a schematic diagram indicating the flow of heat in the system. There are a total of 54 fans which function similarly to those indicated in the sketch.

Four refrigeration compressors of the centrifugal type, using Carrene under partial vacuum, total 900 tons of refrigeration capacity. This is equivalent to about 20,000 domestic refrigerators. These refrigeration machines cool the spray water which conditions the air to a fixed constant temperature and moisture content per pound. Heat is removed from the air by the spray water in summer, and the incoming air has its water vapor content lowered by condensation, called dehumidifying. When this happens the droplets of atomized water become larger. When humidifying they reduce in size by a volume equal to the total evaporation. The refrigeration machines act as a pump to reject heat to the cooling tower water which is at a higher temperature level than the spray water which is chilled to 38 degrees. The cooling towers reject this heat (which originally came from the people and electric lights) into the atmosphere by partial evaporation of the 162,000 total gallons per hour recirculated. These towers with their huge fans, handling twenty million cubic feet of air per hour, can be seen from Sixth Avenue atop the 17th floor of another building in the Rockefeller Center project. Figure 14 shows the refrigeration room.

The minimum amount of air introduced from outside to every space conditioned is 50 times the amount which would be breathed by the maximum occupancy. The amount of air circulated through each studio is 4 times this amount.

The supply fans deliver 15,000,000 cubic feet of air per hour total, but all the fans handle very nearly twice this amount. The total plant connected horsepower is 1,941. Air is handled at an average velocity of 1,000 feet per minute. This varies considerably with the duct work design and sound requirements. The air travels .2 of a mile in the longest round trip run of duct.

Comfort is established by the combined temperature, relative humidity, velocity and direction of air movement. Distribution is from overhead, the supply air leaving plaques in the studios which are horizontal with the ceiling. This air is cooler and therefore more dense than the air below it. It therefore gradually settles toward the floor in a blanket method of diffusion, which takes an av-

(Continued on page 27, advertising section)

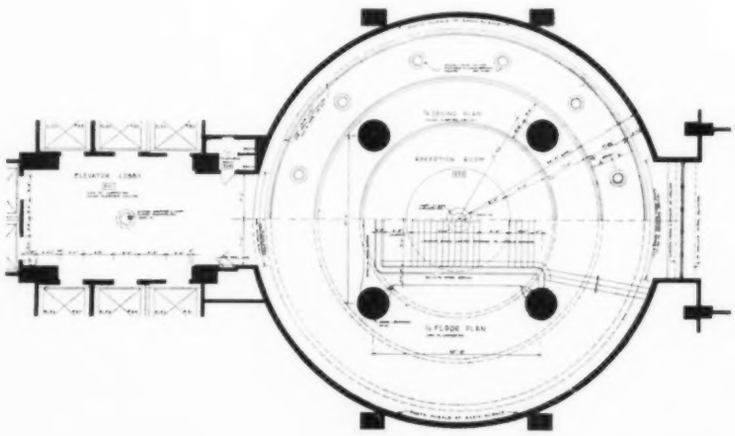


Figure 15 is a plan of the mezzanine reception foyer. This circular room represents a difficult conditioning problem not only because of shape, but because of the open staircase to the ground floor.

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By HENRY L. LOGAN, ENGINEERING CONSULTANT, HOLOPHANE COMPANY
O. B. HANSON, OPERATING MANAGER, NATIONAL BROADCASTING STUDIOS

The lighting problem, complicated as it was by the sonic problem, and further complicated, as it turned out later, by an intricate thermal difficulty, demanded extensive research and experimentation. Each studio had to be so built that no sound could enter from another, nor from any part of the building, and that no sound could leave, except at the will of the control operator. The technical difficulties begin to appear when it is realized that the studios had not only to be grouped in the same building; placed *next* to each other and on *top* of one another, with entrances from the same corridors; with the same ducts, pipes, tubes and other mechanical connections tying them together for heat, ventilation, air conditioning, light and similar services, but had to be located in a building next to the Sixth Avenue Elevated Railway Station, so that the train vibrations would be transmitted through the steel framework of the building containing the studios.

The architectural and artistic handicaps can be understood by considering the limitations imposed by sonic requirements. Every material, every surface treatment, every shape, had to stand the test of sound transmission, sound absorption, sound reflection, sound distortion and so on. Even the glue with which the textile fabrics are fastened to the walls had be be specially sound insulating.

The function of the studios being the production and control of sound, little explanation is required to show why windows and natural light were ruled out at the beginning. Areas that would admit natural light would also admit sound from the outside world. The glass would introduce an interruption into the sound-controlling surfaces of the studios. Adequate natural illumination could have been secured only by windows in two walls, in many studios, thus requiring such studios to have two outside walls, which considerations of planning and economy would not permit. Other reasons will occur to the reader.

Artificial light was therefore dictated by the nature of the requirements so that every studio is entirely isolated from the outside world although the building in which they are housed pushes its way far up into the sunlight.

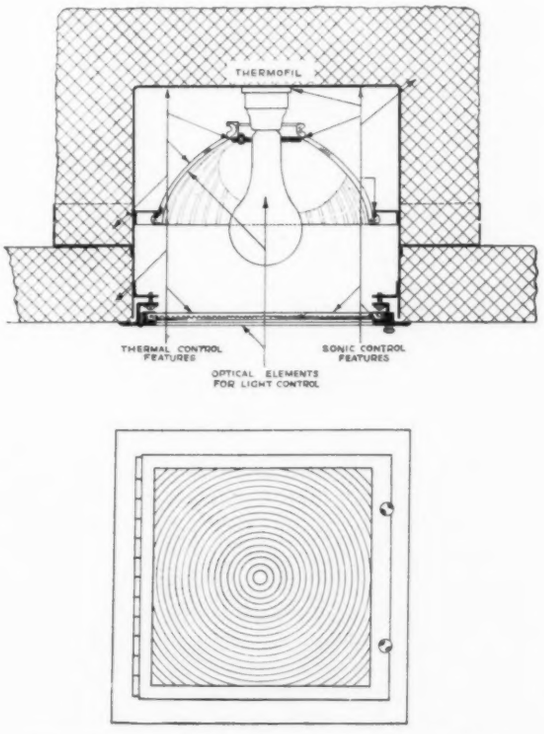
Experience with the lighting of previous studios led to the choice of twenty foot-candles as the desirable level of average intensity. Lower intensities had proved unsatisfactory.

Experience also ruled out hanging fixtures. They introduced distortions into the broadcasts, in the Chicago Studios, by sympathetic vibrations and sound reflections. In the Fifth Avenue Studios, New York, their size, which was necessary to accommodate the wattage required, also interfered with the air conditioning.

Several conferences were held to determine how to secure this intensity with visual comfort, without hanging fixtures, with reasonable wattage economy and architectural satisfaction.

The following criteria were developed from these talks:

1. The equipment should be flush in the ceiling with no projection below.
2. The light should be sharply controlled so that bright glaring rays would not strike the eyes of the performers or spectators while at the same time the scores of the musicians



SECTION AND PLAN OF TYPICAL HOLOPHANE CONTROLENS UNIT FOR N.B.C. STUDIOS

and the scripts of the actors were generously illuminated.

3. Enough light should reach the walls to reveal their decoration and avoid "spotting" or "tunnel" effects.
4. Sufficient light should be returned to the ceiling by reflection from the floor and walls to overcome the contrast between the light-producing areas and the rest of the ceiling.
5. The efficiency of the equipment should be of the highest possible order to keep the power input within reasonable limits and to generate the least amount of heat so that interference with the air conditioning controls would be within a controllable range.
6. The equipment should be designed so that it would not "sing" with the broadcast by parts vibrating in sympathy with particular notes, or by the whole acting as a diaphragm; and it should produce the same acoustical results as the "floating" ceiling in order that the sonic characteristics of this specially-constructed costly ceiling would not be defeated by the holes punctured in it to receive the lighting units.

The first criterion led to the study of "built-in" lighting. Flush, luminous rectangles were decided upon as being in harmony with the rectangular shapes of the studios. Experiments were made

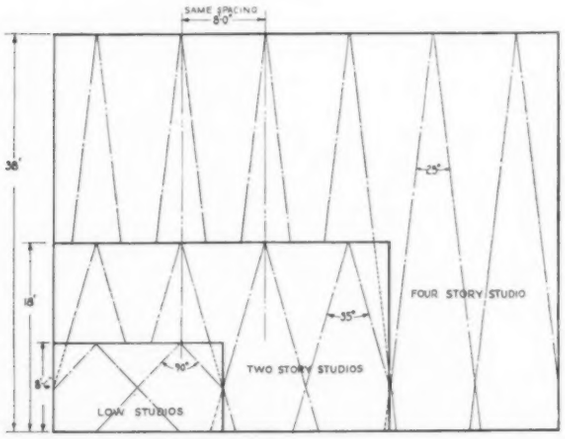


Diagram showing illumination spread in various studios.

with louvers, etched glass, opal glass, controlenses, mirrored, metal and prismatic reflectors. The combination of Holophane controlens and prismatic reflector was adopted because it gave the greatest output of light; controlled it more sharply, permitting the principal beam to be confined to the work plane with a secondary blanket of softer illumination for the walls and figures of the performers, and the prismatic reflector "filled" out the lens best so that its lighted appearance was satisfactory. That is, the lens and prismatic reflector satisfied criteria Nos. 1, 2 and 3 directly.

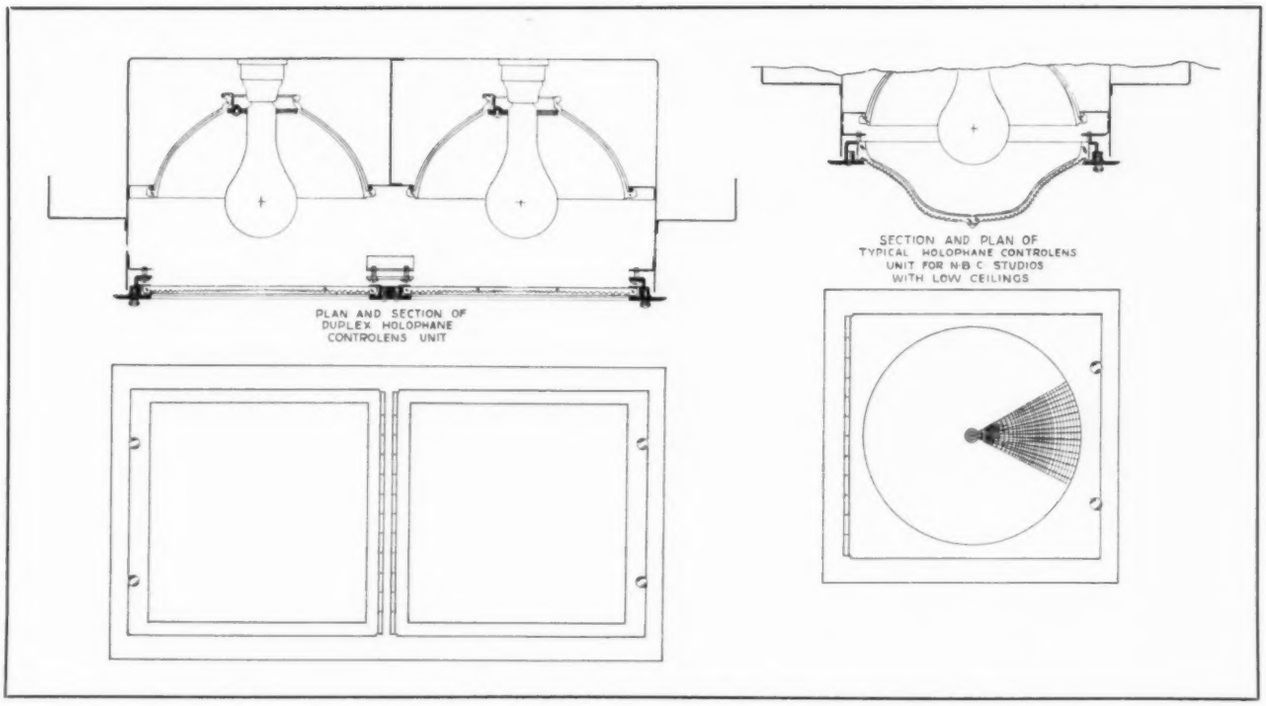
Criterion No. 4 was met by giving the floors and walls finishes that would reflect sufficient light back onto the ceiling.

Suspended light fixtures used in the old N.B.C. quarters were ruled out from the new studios because of sound-distorting characteristics.

The fifth criterion proved a real stumbling block. The use of lenses solved the efficiency difficulty but the question of what to do with the heat that would be generated in the metal housings above the lenses was a poser. Experiments quickly limited the practical lamp size to 200 watts. Larger lamps raised the operating temperature of the equipment too much. That also settled the spacing of the units, as with 200 watt lamps on the sending end and twenty foot-candles on the receiving end simple arithmetic gave the answer to how many lamps were needed for each studio, and what their spacing should be.

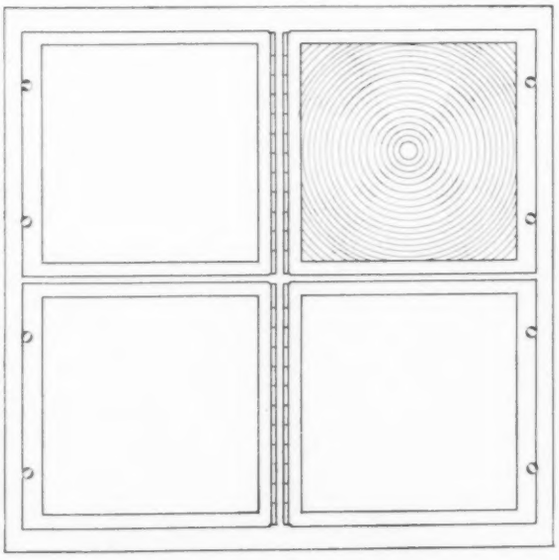
However, that merely brought the investigation to the point where we were satisfied the equipment would operate without failure or deterioration under the temperatures developed in its interior; but that wasn't enough. Each studio was a "box" within a "box," the inside chamber being separated from the outer by a cradle of felt-covered "springs." The space between, above the ceiling of the inner "box," was filled with ducts carrying the air conditioning currents. Heat released from the light hoods that penetrated into this space would affect these currents and play havoc with the control of the air conditioning system. So there was further experimentation.

The aim was not only to drive as much of the light generated by the lamp out through the lens as possible, but also to *send the heat out the same way*. The degree of success that ended the experiments is measured by the figures of the



final test showing that only ten per cent of the heat generated leaked out through the housing into the space around it, the rest going out by way of the bottom of the unit. Curiously enough, the equipment in its final form controls thermal energy even better than it does light.

A cross section through a typical unit is shown above with the optical elements, the thermal control elements and the sonic control features indicated. An examination of this illustration shows that the same parts sometimes control two and even three kinds of energy. That is particularly true of the lens which is a nearly perfect transmitter of luminous energy, a fair insulator for sonic energy (particularly when damped with felt around the edges), and a good transmitter for the short-wave length thermal energy, usually referred to as "radiant heat."



PLAN OF QUADRUPLEX HOLOPHANE CONTROLENS UNIT

Sonic control was achieved by damping all parts with a tendency to diaphragm action, such as the lens and the reflector, with felt, and by tying all metal parts and the entire assembly rigidly together to prevent rattles, then by covering it all over the outside where it projected into the space above the ceiling with the same sound-absorbing material used in the "floating" ceiling, so that the ceiling merely "bent" around it and continued on unbroken, sonically speaking, although optically the ceiling stopped at the edges of the units.

The various ceiling heights complicated matters. The large auditorium studio goes through nearly four stories. The clear height from finished floor to ceiling is thirty-eight feet. Some of the one-story studios are at the other extreme being only 8½ feet high. Normally these great differences would be reflected in proportionate wattage changes. The higher the ceiling the more the wattage. The use of the lenses made it possible to reconcile this wide range of heights *without proportionate changes in wattage.*

A convex lens, bulging slightly downward into the room, was selected for the lowest studios with a light spread for the principal "beam" of 90°.

A flat lens was used in the two-story studios that compressed the same quantity of light into about a 50° spread so that the greater height was compensated for by "squeezing" the light into a narrower cone and putting as much onto the work-

Sigurd Fischer

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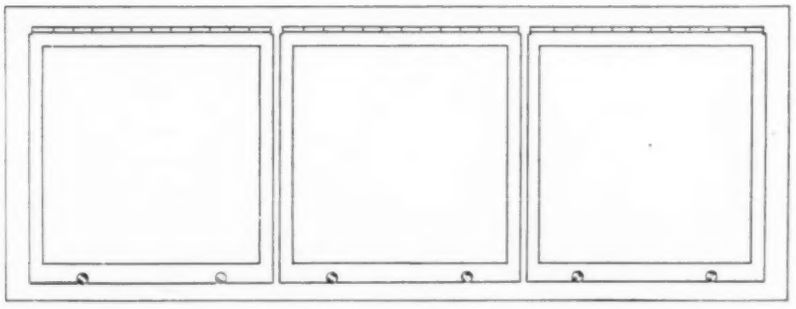
REINHARD AND HOFMEISTER; CORBETT, HARRISON AND MACMURRAY;
HOOD AND FOUILHOUX, ARCHITECTS



PLAN OF TRIPLEX HOLOPHANE CONTROLENS UNIT

ing plane with the same average wattage per square foot of area, as for the lower ceilings.

The same lens was used in the four-story studio but the lamp and reflector settings were changed to "squeeze" the light still more, this time into about a 30° beam so that again the same average wattage could be used to secure the desired intensity.

The diagram on page 90 will make this clear. Measurements taken since the installation has been completed show that the average wattage per square foot for all the studios is a little under four, and the average intensity is a little better than twenty foot-candles.

The engineering requirements of the lighting system were so rigid that architectural considerations were subordinated, but all comments that have reached the writers dealing with the architectural features of the lighting have praised them. Perhaps this is evidence in favor of the viewpoint that holds the surest way to beauty is to satisfy the "function" of a "creation."

PANEL HEATING

By ALFRED ROTH, Architect*

Panel heating, initiated by Richard Crittall & Co., Ltd., London, is a warm-water heating system, with water circulation by pump or gravity. Heat is transmitted to rooms, not by radiators or exposed pipes, but is literally radiated into the rooms by means of warm surfaces of plaster or other suitable material (generally with the aid of concealed coils in walls, floors, and especially in ceilings).

The heating effect of this system is fundamentally different from the one attained by radiators. We know that heat can be emitted either by convection or by radiation. In ordinary heating units (radiators, pipes), both kinds of heat emission are in effect, one more, the other less, depending upon construction and position of the unit. In heat distribution by convection the air surrounding the unit has first to be brought to the desired temperature and then carried into the room. This results in a constant air circulation. Contrary to this, in heat distribution by radiation alone, no practical rise in temperature affects the air between the heat-emitting and the heat-receiving bodies.

Panel heating is based on this principle of heat dispersion almost entirely by radiation. As a result, a characteristic of the system is that the effect of warmth is perceived before a thermometer, protected against radiation of heat, registers the desired room temperature.

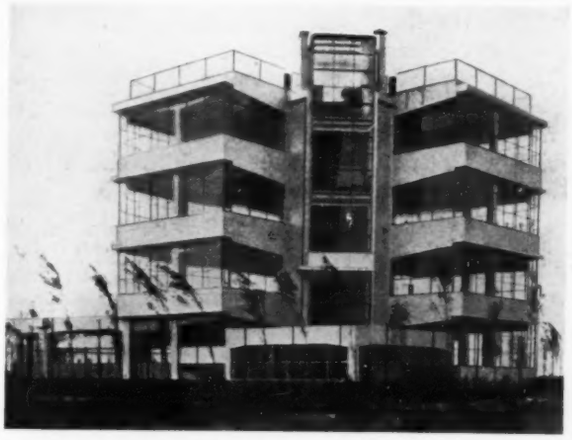
We have all been so accustomed to surrounding ourselves with an indoor atmosphere of hot air in winter that at first it will be difficult for many to realize that they can be kept comfortably warm by radiant heat, even in air considerably cooler than 70°; but experience has shown conclusively that this is the case.

In the panel-heating system, in the ordinary case, a portion of the ceiling radiates heat downward into the room; this radiant heat is reflected at various angles by the walls of the room, the furniture, and so on, and impinges on the occupants from above and from all sides. The radiant heat is absorbed directly by the surface upon which it strikes (in proportions which depend upon the nature and color of the surface), and thus warms the occupants, the furniture, the floors and, to a lesser extent, the walls of the room. So far the air of the room has played no part in the process, but the warmed walls, furniture, and even the occupants, of course, give out heat slowly to the air, so that it is warmed somewhat by a "secondary convection" (although at a much lower rate than with ordinary heating systems). The result is that the occupants can be kept as comfortable by mild radiant heat as in the ordinary 70° room temperature, although the air itself

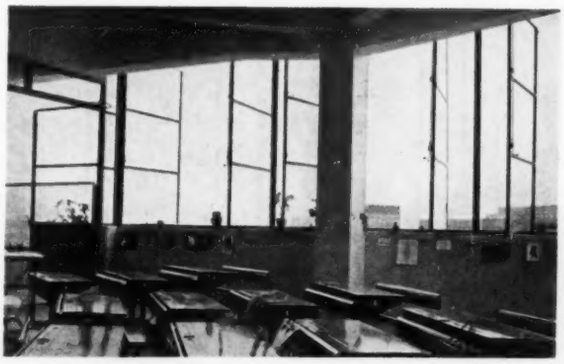
*Application in U.S.A. by Wolff & Munier, Inc., Engineers, N.Y.C. Article translated by A. Frey, extracted from *Schweizerische Bauzeitung*, Zurich.

Stewart Bale

Norris Green Pavilion School, Liverpool, England. A feature of this school is the close relation of classrooms and out-of-doors. Panel heating makes this opening of the rooms possible for the entire year.



Open-Air School in Amsterdam, Holland. J. Duiker, architect. Every classroom in this vertical arrangement has a connected terrace for out-of-door teaching.



Classroom interior, Open-Air School in Amsterdam. With panel heating in ceiling, heat is radiated downward (not circulated), permitting open windows during cold weather out of doors. Window areas may be large without much heat loss.

is several degrees lower in temperature than is usual with any other form of heating.

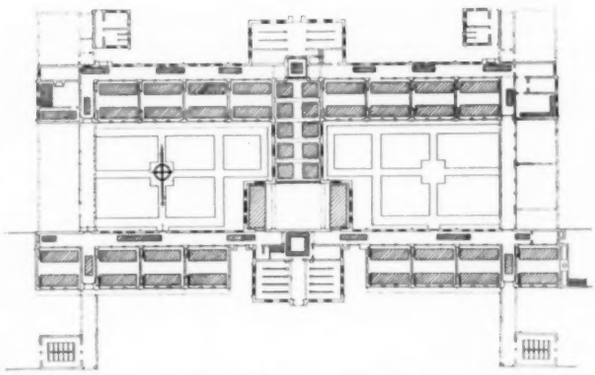
In the first experiments, coils were embedded in walls, floors, and ceilings. It has been found, however, that heat from ceilings alone is sufficient in most cases. This might seem paradoxical at first because with ordinary steam or hot-water heating we endeavor to place heating surfaces as near as possible to the floor level (under windows, for example). In regard to heat transmission by convection this conclusion is right, since heated air tends to rise. For panel heating, however, operating almost exclusively by radiation, this conclusion is out of consideration. The radiation from the surface of the temperately-heated ceiling is mild and even.

The water used for heating is never heated to a temperature greater than 135°, and the radiating surface reaches a temperature of about 120°. The warmth is the more agreeable when it is mild. Lowest surface temperatures and largest heat-radiating areas, evenly distributed over the entire room, give best results. The heating effect coming from above is not only agreeable but is perceived as natural, because we are used to it from the sun. It would seem that with a surface radiating heat from the ceiling, the floor would be cold, but actually the floor is the warmest space apart from the ceiling. This is due to the fact that the radiant heat not only strikes the human bodies, but every object in the room and especially the floor directly under the ceiling, which absorbs the heat and becomes a radiating surface.

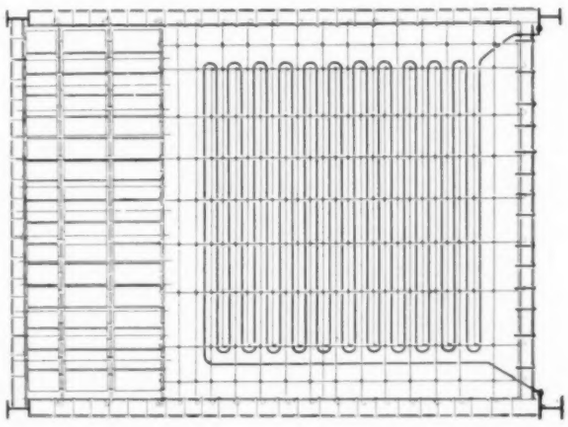
Panel heating requires the burying of coils of steel pipe in the building construction, immediately behind the surface which is to radiate the heat. Water is circulated through these coils at a temperature which is made to vary according to the weather. Heat from the water is conducted through the metal of the pipe and through the construction materials to the plaster surface which is kept warm, the pipes being so spaced as to maintain an approximate uniform temperature for the whole area of the panel.

To obtain the desired results it is necessary to have intimate contact between the pipe coils and the building construction which forms the panel. This has been achieved both by casting the coils in the bottom of a stone concrete arch and, in this country, by hanging the coils at the suspended ceiling level and applying the wire lath and plaster directly to the coil pipes. The advantage of the latter method (which better fits the usual American construction) is that there is a smaller mass to heat and cool, with the result that the system responds more quickly to the rapid changes in temperatures encountered here.

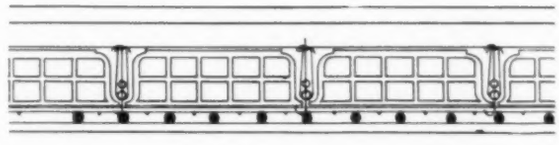
Heating panels may be located behind any type of building material which has a fairly good coefficient of heat conduction. In England it is quite common to place panels which, for various reasons, are not in the ceilings, behind marble bases, or under terrazzo floors. There have been a number of cases where heating panels have even been



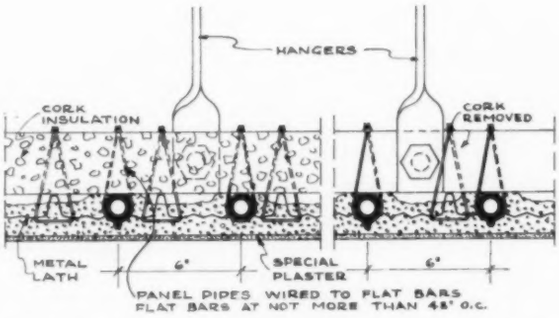
Norris Green Pavilion School, Liverpool, England. Heating panels at ceilings of classrooms and corridors are indicated by dark areas.



A typical ceiling panel, showing pipe coils, and risers and returns at columns.



Section of floor with coils suspended at ceiling. The coils with frame are suspended to the steel floor framework.



Detail of ceiling, showing suspension of pipes. Metal lath is attached to these pipes. The pipes are then embedded in a special plaster suited to heat radiation. The space above the pipes and plaster is filled with cork insulation.

located behind large mirrors, and the mirror surface actually radiates heat, as well as reflects light. Wood and similar porous materials do not make very satisfactory heating panels, because of the resistance they offer to the conduction of heat from the coil to the surface of the panel.

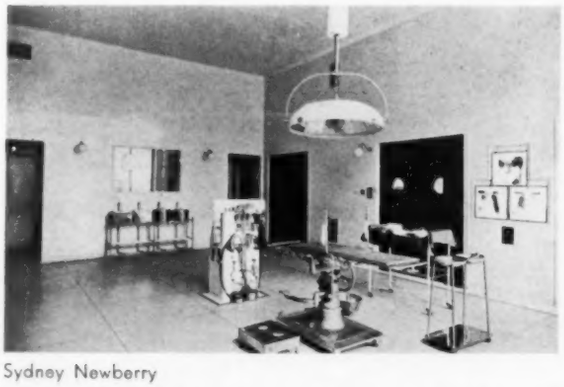
The usual panel surface, of course, is plaster, and this is practically the invariable surface in the case of a conventional coil location in the ceiling. Through the use of a special grade of plaster, reinforced by the application of "scrim" troweled into the freshly-applied white plaster, any danger of cracks is overcome. The scrim becomes embedded in the plaster in such a manner as to be practically invisible (except that it gives a "textured" surface).

The method of heating hot water for the panel heating system depends entirely on the requirements of the building and the desires of the owner. Coal, oil or gas may be used as a fuel; or steam from a central distributing system can be used with a hot-water converter for panel heating. The hot water for the system can be circulated either by gravity or by pump; pump circulation is preferable as it results in smaller pipe sizes and more rapid heating and cooling. With circulation by cooled water the system can aid in keeping rooms comfortable in summer.

Panel heating, due to the fact that it is entirely concealed and an integral part of the construction, gives the architect a wide range of treatment in the design and finish of the rooms. This is of special importance from hygienic and aesthetic standpoints.

It is of course necessary, owing to the construction, that the architect and builder, as well as the heating contractor, work in conjunction both as to the design and installation of the system. The coils and branches must be installed before pouring the arches (if embedded therein), or before applying

Sanatorium Paimoni in Finland. Alvar Aalto, architect. Heat radiating units are here visibly applied at ceiling, affording unobstructed floor area and flexibility in lighting and ventilating.



Sydney Newberry

Interior of Sanatorium Paimoni, Finland. Alvar Aalto, architect. The requirements of rooms for tubercular patients do not demand evenly distributed heat but concentration upon the foot-ends of beds. Pure air is also essential. Panel heating makes possible the opening of windows without exposing the patient to the danger of catching cold. The advantage of this method of heating for the operating room is obvious.

wire lath and plaster (if hung ceiling panels are used). All pipe work is welded and tested in order to prevent any danger of leaks. The small loss of time due to the installation of panel heating at this stage of the construction is more than offset by the saving in time effected in the finish of the building owing to the omission of radiators and grilles.

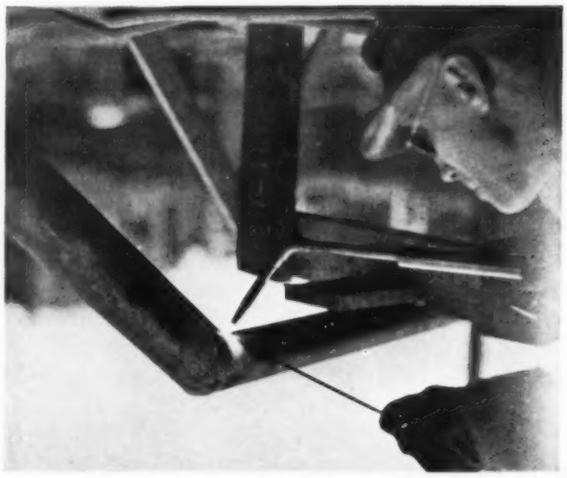
Panel heating has been installed for some years in many types of buildings, such as hospitals, residences, office buildings, and public buildings, and it has also found special uses, in open-air schools (where, because of the radiant heat, the occupants feel warm while the windows are open), and the heating of tile floors around swimming pools.

From the standpoint of comfort, and of the preservation of perishable materials, the advantages of panel heating are as great as from the aesthetic standpoint. In common with all hot-water heating systems, the amount of heat liberated can be regulated easily and conveniently, at the central boiler plant, to suit the requirements of the weather, so as to avoid the overheating (in average mild weather) which is so characteristic of most steam heating systems. However, panel heating enjoys further advantages which are *not* present in other hot-water heating systems; these are derived from the essential feature, that *radiant* and not convected heat, is used. This radiant heat will maintain complete comfort with an air temperature several degrees lower than is necessary with other methods of heating. The result of this cooler air is a delightful sense of freshness, without any chill. At the risk of repetition, the point should here be stressed that the radiant heat from the panels is picked up directly by the skin and clothes (as well as by the furniture and floors), which are thus kept comfortably warm in air considerably cooler than when the only source of heat is the air itself.

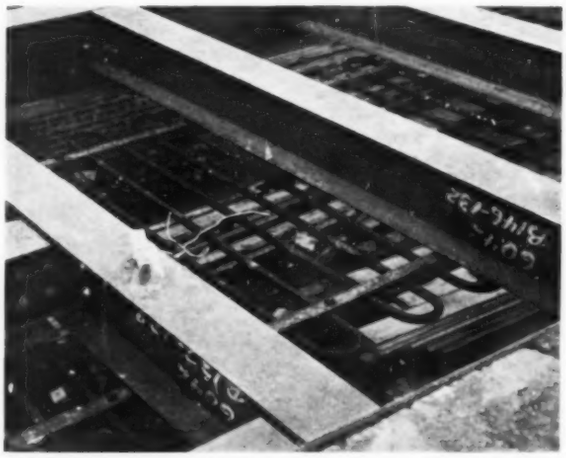
Panel heating thus offers a comfort which is somewhat analogous to out-of-door living. As a result we become accustomed to panel-heated rooms immediately. In addition, this method of heating creates living conditions which eliminate the hazards occurring through change from outside to inside temperatures, such as catching cold.

From an operating point the installation of panel heating shows considerable economy. The average outdoor temperature, throughout the heating season, is in the neighborhood of 42° (New York City); with 70° room temperature, the temperature difference from indoor to outdoor averages 28°, while with panel heating it will only average about 20°. In the British Embassy Building, Washington, D. C., which was the first installation of panel heating in this country, it has been found that there was a saving of at least 40 per cent in fuel.

Panel heating forming an integral part of the structure has theoretically or practically no influence upon floor layouts. It even underlines the free disposition of partitions which skeleton construction has made possible. A further advantage of the complete disappearance of heating units is in the space gained for furniture.

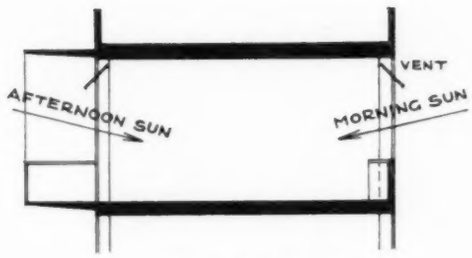


Pipes for panel heating as installed in the United States are welded.

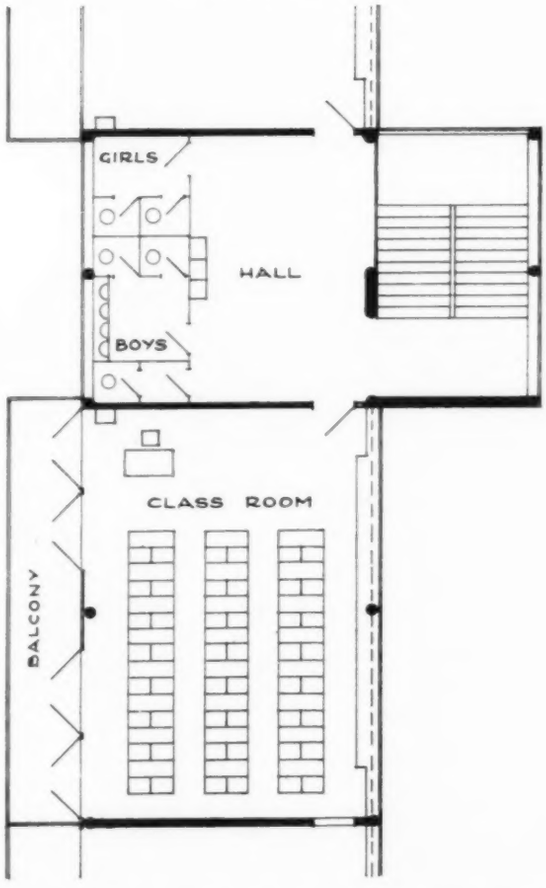


Hot water pipes placed under the beams before applying metal lath and plaster. British Embassy Building, Washington, D. C.

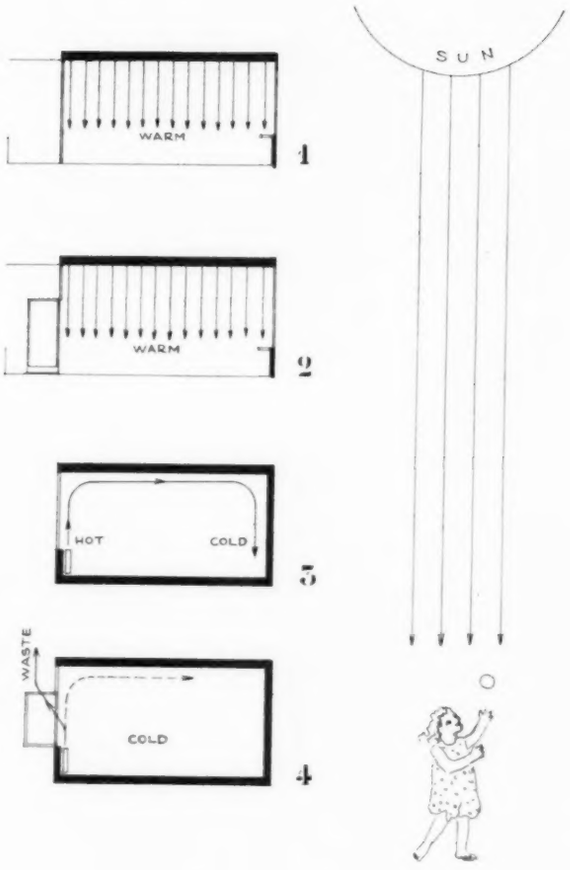
Heating coils are embedded in plaster at ceiling—with minimum mass to be kept at even temperature.



Section of typical classroom.

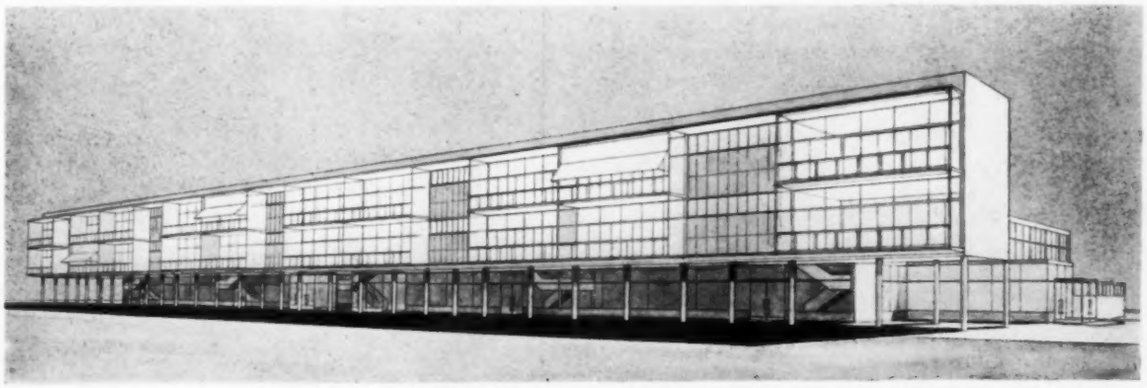


Plan of typical classroom and central stair hall. Stairways serve two classrooms at each floor level.

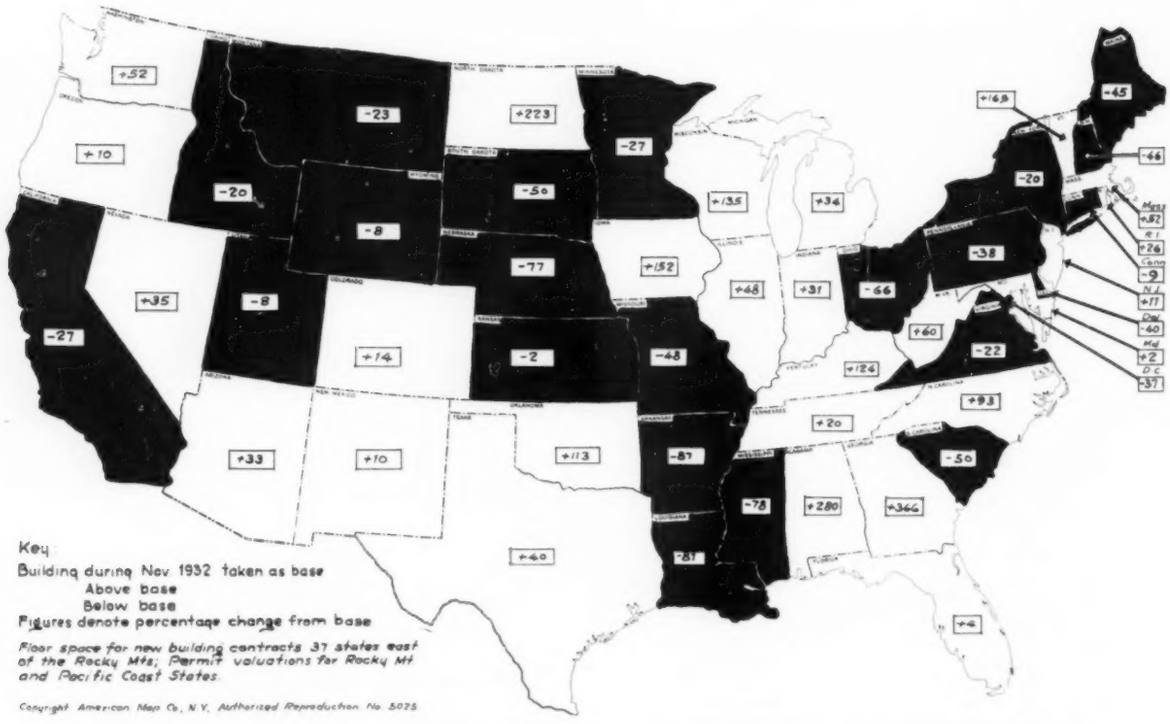


Diagrammatic indication of heat from ceiling panels of proposed Open-Air School in Zurich, Switzerland. (1) Vertical direction of heat radiated from ceiling. The air within classroom is not heated. (2) The opening of doors or windows does not upset heat radiation. (3) Circulation of air by ordinary wall radiator methods. (4) When radiators are placed beneath open windows, heat escapes and cold air takes the place of the lost heat.

It is well known that the heating of air reduces its relative humidity. In severe winter weather the air that has been heated from a very low temperature to about 70° is actually *drier* than the summer air of deserts.



Proposed open-air school in Zurich, Switzerland. A. Roth, architect. In recognition of the effects of panel heating, the classrooms are disposed for admittance of light and sun from two sides and for cross ventilation. Each classroom, to the southwest, has a balcony upon which glazed doors open for the entire width of the room. By this arrangement the classrooms may be converted to out of doors without having pupils leave their seats.



BUILDING TRENDS AND OUTLOOK

By L. SETH SCHNITMAN, Chief Statistician, F. W. Dodge Corporation

Construction contracts awarded in the 37 eastern states during the full year 1933 amounted to $1,256,000,000 as contrasted with the total of $1,351,000,000 for 1932; this, it is seen, is a decline of about 7 per cent between the two years. For the first half of 1933, contracts were running 35 per cent behind the corresponding period of 1932; thus it is clear that during the final half of the year a considerable speeding up in contracts took place even though such improvement was not quite sufficient to offset completely the loss recorded during the initial half.

For December alone the contract total amounted to $207,209,500; this was a gain of almost 28 per cent over the November total of $162,330,600 which itself was almost 12 per cent larger than in October. In fact, the December contract volume was more than 2½ times as large as the total recorded in December, 1932. Increases over December, 1932, were fairly general both as to geographical location and as to major construction types. Thus, for residential building the gain approximated 85 per cent; for nonresidential building, December awards were twice as large as those reported a year earlier; while for public works and utilities combined, December contracts were more than three times as great as the total shown for December, 1932.

It is of interest, too, to indicate that out of the December total of $207,209,500 for all awards east of the Rockies, publicly-financed contracts accounted for $155,862,800; this represented about 75 per cent of all contracts for the month.

MATERIAL PRICE MEASURING ROD*

The prices in this tabulation enable one to visualize at a glance the main trend of the material market. Their significance does not extend beyond that point, and the explanation below should be read carefully.

F. W. Dodge Corporation Composite Prices as Indicated in Explanation—

Material	This Month	Month Ago	Year Ago
Portland Cement	$2.20	$2.20	$2.05
Common Brick	12.34	12.34	11.75
Structural Steel	1.65	1.65	1.60
Lumber	16.44	16.37	15.50

Prices given in this comparison are composite and do not in all cases refer to one item. For instance, the price of structural steel is the composite of prices of shapes and plates f.o.b. Pittsburgh; the price of lumber is a composite of five items of Southern pine and five items of Douglas fir f.o.b. mill; the price of cement is a composite of prices in fourteen different cities per barrel, carload lots, to contractors: price of brick is composite in fourteen cities per M, delivered on the job.

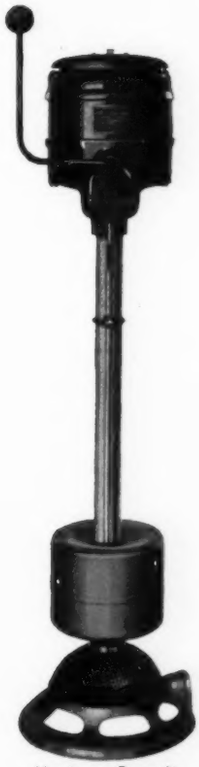
*As previously published in *General Building Contractor*.

Constructed of
COPPER AND BRONZE THROUGHOUT

PENBERTHY AUTOMATIC ELECTRIC SUMP PUMPS

Maximum Capacity 3600 Gals. per Hr.

Model K
Made in 5 Sizes
Retail Price
(Size No. 1 K)
$65.00



Maximum Capacity 1400 Gals. per Hr.

Model 33
Made in 1 Size only
Retail Price
$39.50

Their performance is as superior as the materials from which they are made. There is a Penberthy Pump for every purpose . . . and to suit every pocketbook.

PENBERTHY INJECTOR COMPANY
Manufacturers of Quality Products Since 1886
Detroit, Michigan **Windsor, Ontario**

PENBERTHY

SELECT THE PUMP THAT SUITS THE PARTICULAR CONDITIONS . . . DON'T TRY TO SUIT THE CONDITIONS TO A PARTICULAR PUMP

NRA

PENBERTHY AUTOMATIC CELLAR DRAINERS
(Water and Steam Operated)

MODEL S
Made in 1 Size Only
Maximum Capacity
600 gallons per hour
Retail Price . . $14.50

MODEL R
Made in 2 Sizes

	Max. Cap. gal. per hr.	Retail Price
1R	720	$25.00
2R	1240	40.00

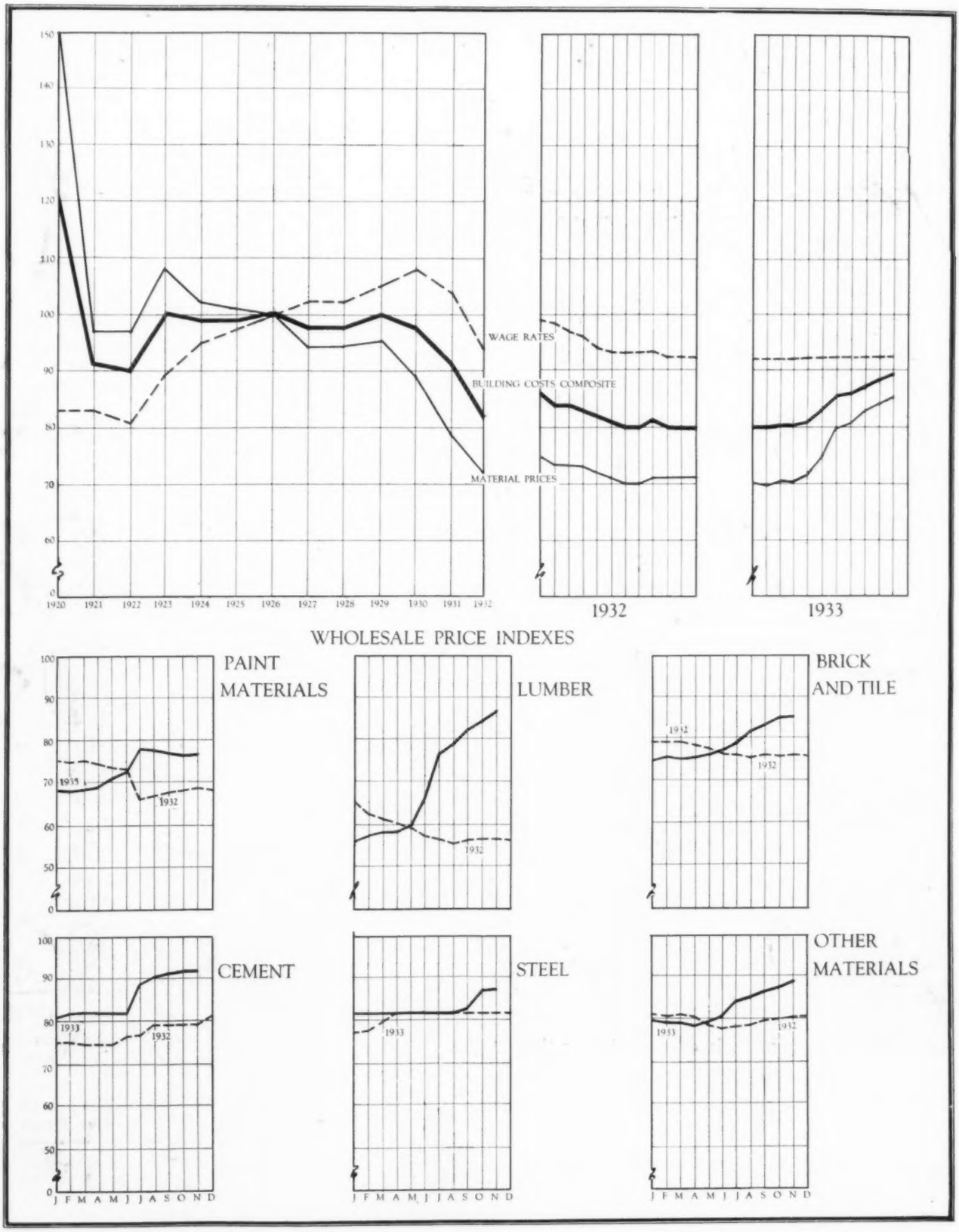
MODEL L
Made in 3 Sizes

	Max. Cap. gal. per hr.	Retail Price
3L	1650	$ 55.00
4L	2400	80.00
5L	3200	110.00

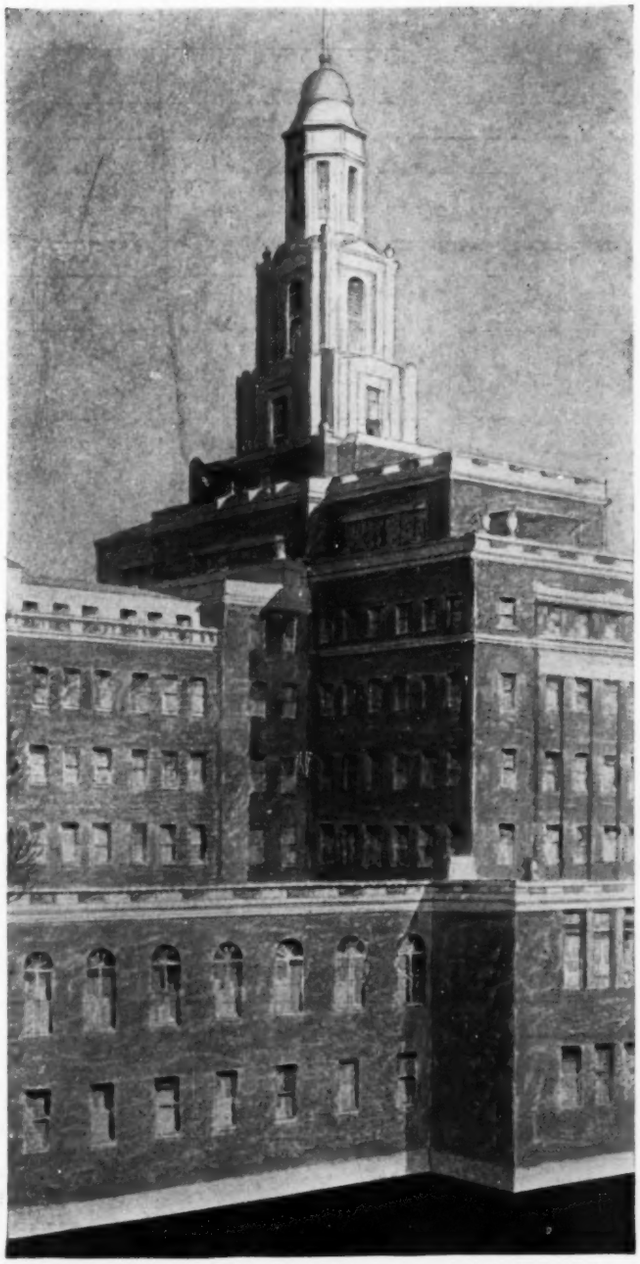
PENBERTHY PUMPS REMOVE SEEPAGE WATER

MATERIAL PRICES, BUILDING WAGE RATES AND BUILDING COSTS COMPARED

1926 Monthly Average = 100



Aetna got the facts and Sealex got the order



Aetna Life Insurance Co. Building, Hartford, Conn. James Gamble Rogers, Architect

It was not by chance that Sealex Floors were specified for Aetna and 88 other great insurance companies.

In the case of Aetna, for example, tests were conducted for one solid year. The purpose was to find a better floor than Sealex for the same money—or as good a floor for less. Aetna's tests clearly showed that Sealex was the "preferred risk"—the *preferred buy* for their offices. 270,000 square feet of Sealex Battleship Linoleum were installed in the Aetna building shown here.

To land orders of this magnitude, Sealex must possess not one or two, but many points of superiority. These floors are quiet and resiliently comfortable to walk on—increasers of employee efficiency. They are hard to wear out but easy to maintain—decreasers of overhead expense.

In addition to these requirements of a commercial floor, insurance companies are interested to a great degree in the non-skid properties of our flooring. Here, too, Sealex Linoleum offers the most in resilient floors. Tests in actual use and in university laboratories have proved that Sealex Linoleum offers a high coefficient of friction under foot traffic.

When Sealex Linoleum or Sealex Wall-Covering is installed by an authorized contractor of Bonded Floors or Bonded Walls, both workmanship and materials are backed by a Guaranty Bond. See our catalogue in Sweet's, Volume B, for further facts . . . or write us for further information.

CONGOLEUM-NAIRN INC.
211 Belgrove Drive, Kearny, New Jersey

SEALEX
REG. U. S. PAT. OFF.
FLOORS AND WALLS

NRA MEMBER U.S. WE DO OUR PART

● *Acres and acres of Sealex Linoleum Floors are giving all-round satisfaction to such nationally known insurance companies as:* American . . . American Mutual . . . American National . . . Atlas Assurance . . . Commerce Casualty . . . Connecticut General Life . . . Connecticut Mutual Life . . . Continental . . . Equitable Life Assurance . . . John Hancock . . . Home . . . Hartford Accident . . . Hartford Fire . . . Home Title . . . Kansas City Life . . . Liverpool, London & Globe . . . London & Lancashire . . . Maryland Casualty . . . Metropolitan Casualty . . . Metropolitan Life . . . Mutual Benefit Life . . National Fire . . . New York Life . . . Northern Assurance . . . Pacific Fire . . . Pennsylvania Company for Ins. on Lives & Granting Annuities . . . Phoenix Provident Mutual Life . . . Prudential . . . Royal . . . Royal Indemnity . . . Security . . . Sun Indemnity . . . Sun Life Assurance . . . Travelers . . . and many others.

WAGE SCALES IN THE BUILDING TRADES

Information Furnished by National Association of Builders Exchanges and Compiled by Division of Statistics and Research, F. W. Dodge Corporation, as of December, 15, 1933

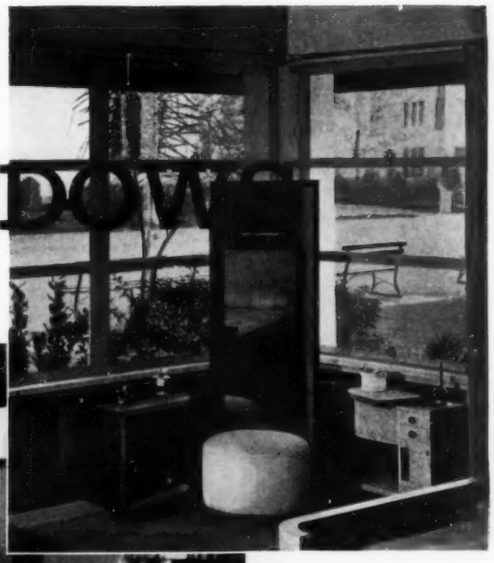
	Asbestos Workers	Bricklayers	Bricklayers Tenders	Carpenters	Cement Finishers	Electricians	Hoisting Engineers	Iron Workers—Ornamental	Iron Workers—Structural	Laborers	Lathers	Painters	Plasterers	Plasterers' Tenders	Plumbers	Roofers—Composition	Roofers—Slate & Tile	Sheet Metal Workers	Steamfitters	Stone Masons	Tile Setters	Tile Setters' Helpers
Akron	$1.00	$1.25	$0.45	$0.70	$0.70	$0.75	$0.70	$0.60	$0.60	$0.40	*$0.87½	$0.65	*$1.00	$0.62½	$0.85	$0.80	$0.80	$0.80	$0.85	*$1.25	*$1.25	*$0.50
Atlanta	1.00	1.25 1.40	‡.30 .45	.70	1.25	.90 1.10	.60 1.00	.35 1.85	1.25	.25 .35	1.00 1.25	.75	1.25	.30 .45	1.25	.80	.80	.90 1.00	1.25	1.00 1.25	1.25	.40
Baltimore	1.00	*1.00	1.00	.65	*1.00	*1.00	*1.25	*1.37½	*1.37½	.20 .30	*1.25	.80 *.90	*1.25	1.00	*1.00	.75	.75	*1.12½	*1.00	1.00	1.25	.72
Boston	1.25	*1.30	.70	*1.17½	1.17½	*1.25	1.17½	*1.20	*1.20	.70	*1.25	*1.12½	*1.37½	*.95	*1.25	*1.17½	*1.05	1.17½	*1.25	*1.30	*1.30	*.95
Buffalo	1.00	*1.12½		*1.00	.90	*1.00	1.00	1.12½	1.12½	.30 .50	1.00	*1.00	1.00		1.00	.50	1.00	1.00	*1.00	*1.12½	*1.18¾	
Chicago	1.37½	1.50	.82½	*1.31¼	1.31¼	1.50	1.31¼	1.31¼	1.35	.82½	*1.37½	1.41	*1.37½	.88¾	1.37½	1.37½	1.40	1.37½	1.37½	1.50	1.37½	1.00
Cincinnati*	1.15	1.25	.70	1.20	1.02½	1.25	.80 1.25	1.25	1.25	.45	1.31¼	1.15	1.37½	.70	1.25	.92½	1.07½	1.07½	1.12½	1.00	1.00	
Cleveland*	1.17½	1.25		1.12½	1.12½	1.37½	1.12½	1.25	1.25	.72½	1.25	1.00	1.25		1.25	1.15	1.37½	1.12½	1.25		1.25	.81¼
Columbus	1.00	1.30	.62½	.80	.80	1.00	1.15	1.25	1.25	.40	1.00	.80	1.00	.62½	1 00	.80	1.00	.80	1.00	.75	1.25	.50
Dallas††	10.50	10.00	.50	8.00	10.00	*11.00	10.00	10.00	10.00	.35	10.00	*9.00	*10.00	*.50	12.00	8.00	9.00	*10.00	12.00	10.00	*12.00	†*.75
Dayton*	1.25	1.30	.80	1.00	1.15	1.55	1.25	1.35	1.35	.35	1.10	1.00	1.25	.80	1.15½	.85	1.00	1.00	1.15½	1.30	1.50	.60
Denver††	9 00	12.00 *13.00	6.50 7.00	10.00	10.00 11.00	10.00 11.00	10.00	10.00 11.00	10.00 11.00	4.00 5.00	11.00	*10.00	12.00	7.00	11.00	7.00 8.00	7.00 8.00	9.00	9.50	12.00 13.00	10.50	†.62½
Des Moines	1.00	1.25	.65	1.00	1.00	1.00	1.00	1.00	1.00	.55	1.00	1.00	1.25	.75	1.25	1.12½	1.12½	1.12½	1.25	1.50	1.25	.80
Detroit	1.37½	1.25 max.	.55 .60	.80 1.00	.70 .90	1.25 1.40	.60 1.00	1.00 1.20	1.00 1.25	.50 .55	1.37½	.80 1.00	1.00 1.25	.70 .80	1.00 1.50	.70 .90	.80 1.00	.80 1.00	1.25 1.50	1.25 1.50	1.00 1.25	.80
Duluth	1 00	1.00	50	.80	.80	1.00	.80		1.00	.50	.80	.80	1.00	.70	1.00	70	1.00	85	1.00	1.00	1.00	1.00
Erie		1.00	45 .50	.80	.80	.90 *1.00	.90	.60 .80	.90	.35	.90	.60 .70	1.00	.40 .50	1.00	.50 .60	.80 .90	.80 .90	*1.00	1.00	.80	.40 .50
Grand Rapids	.65 .80	1.25	.40	.60	.65	.90	.75	.80	1 00	.35	.80	.60	.80	.40	.90	.50	.70	.70	.90	1.25	1.25	.50
Houston		1.00	.35	.75	.75	1.00	.75	1.00	1 00	35		.62½	1.00	.35	1.00	.75	1.00		1.00	1.00	1.00	
Indianapolis	1.32½	1.62½	.90	1.22½	1.17½	1.50	1.37½	1.45	1.45	.40 .45	1.37½	1.25	1.57½	1.00	1.00	.60 .90	1.27½	1.22½	1.50	1.62½	1.50	.60
Kansas City	.90	1.32½	.80	1.00	1.00	1.00	1.00	1.00	1.00	.60	1.00	1.00	1.06¼	.80	1.00	.92½	.92½	1.00	1.00	1.12½	1.25	.62½
Los Angeles††	10.00	8.00	6.00	7.00	8.00	7.00	8.00	9.00	10.00	4.00	10.00	7.00	9.00	6.00	9.00	7.00	7.00	8.00	10.00	8.00	6.00	†.75
Louisville	1.12½	1.00	.50	.80	1.00	1.00	1.00	1.00	1.00	.25 .35	1.12½	.90	1.00	.50	1.12½	.30 .50	.85	.85	1.12½	1.25	1.00	.50
Memphis	1.00	1.37½	.50	.50	.50	1.00	.75	.75	.75	.20	1.00	.75	1.25	.50	1.25	.25 .40	1.12½	1.12½	*1.25	1.37½	1.25	.50
Milwaukee	1.00	1.00	.75	.92½	1.00	1.25	1.00	1.05	1.05	.60	1.00	1.00	1.00	.75	1.00	1.00	1.00	.92½	1.00	1.00	1.00	.75
Minneapolis	1.00	1.00		.80	80	1.00	.80	.90	1.00	.45	.75 .85	.80	1.00	.70	1.00	.70	.70	.80	1.00	1.10	1.00	.65
Nashville		1.00		.60 .75	.50	.75		60	.75	.30	1.00	.62½	1.00		1.00	60	.80	.60	.75	.50	.75	
New Haven*		1.20	.50 .60	.80 1.06¼	1.20	.80 1.00	1.16¾ 1.27½	1.37½	1.37½	.45 .65	1.27½	.80 1.00	1.20	.50 .60	1.06¼		1 50	1.06¼	1.06¼	1.20	1.20	
New Orleans	.65 .80	1.25	.85	.55 .75	1.00	1.25	1.25	1.25	1.25	.35 .50	1.25	.75 .90	1.25	.75	1.00 1.25	.40	.90 1.15	.90	1.05 1.25	1.50	1.25	.35
New York City††	11.20	13.20	8.00	11.20	c11.20	11.20	12.40	11.20	13.20	6.60	11.20	9.00	12.00	8.50	c12.00	10.28	12.62	11.20	11.20	13.20	11.50	8.50
Oakland††	6.40	10.00	5.60	7.20	8.00	8.00	8.00	7.20	9.60	5.00	8.00	7.00	8.80	6.00	8.00	6.40	6.40	1.18	8 00	9.00	8.00	5.00
Oklahoma City††	8.00	8.00	4.00	6.00 8 00	8.00	6.00 8.00	8.00	8.00	8.00	3.50	.80	7 00 8 00	.80	4.00	.80	6.00	6.00	8.00		11.00	†.62½	
Omaha	1.32	1.00	.45	.80	.90	1.00	1.00	.90	.90	.35	1.00	.80	1.00	.45	1.00	.72½	.87½	.87½	1.00	.90	1.00	.50 .60
Philadelphia	1.00	1.50		1.00	1.05	1.25	1 18½	1.25 1.37½	1.00 1.37½	.40	1.37½	.62½	*1.37½	.90	1.15	1.00	1.25	1.25	1.15	1.00 1.25	1.25	
Pittsburgh	*1.50	*1.50		*1.25		*1.56¼	1.37½ 1.43¾	*1.37½	1.37½	70	*1.50	.87½	*1.50		1.50	*1.25	*1.50	*1.31¼	*1.50	*1.40	1.33¾	88.
Portland, Ore.††	8.00	*9.60	7.20	7.20	*7.20	*8.00	6.40 9.60	6.80	8.80	4.80	*8.80	7.04	*9.60	*7.20	*8.80	7.20	7.20	*8.00	*8.80	*9.60	8.00	7.20
Reading	.70 .80	.90	.75	.75	.85	.75				.35	.75	.70	.85	.75	.90		.80	.80	.90	.75	.90	.50
Richmond	.60 .65	1.25		.40 .60	.35 .50	.80		.20 .70	.70	.20	1.00	60	.60		1.00	.25 .60	.25 60	1.00	.90	.75	1.25	
Rochester	.91	1 12½	.55	* 90	*1.12½	*1.15½	.90	.70-*1.00	.70-1.00	.55	.90	* 90	*1.12½	.55	*1.06¾	*.80	*.80	.90	*1.06¾	*1.12½	1.12½	.47½
Salt Lake††		9 00	5.00	7.20	8.00	8.00	8.00	8.00	8.00	4.00	8.00	7.20	9.00	6 50	8 00	7.20	8.00	8.00	8.00	9.00	8.00	4.00
San Antonio††	6.00 10.00	6.00 10.00	2.00 3.00	2.00 7.00	3.00 8.00	3.00 7.00	4.00 7.00	1.75 4.50	5.00 10.00	1.50 2.50	4 00 7.00	3.00 7.00	4.00 8.00	2.00 3.00	5.00 8.00	5.00 6.00	4.00 6.00	3.00 7.00	5.00 8.00	3.50 8.00	4.00 10.00	2.00 3.00
San Francisco	6.40	9.00	7.00	7.20	7.20	9.00	9.00		9.60	5.00	8.00	7.00	8.80	7.50	8.00	8.00	8.00	7.20	8.00		8.00	5.00
Seattle††	8.00	9.60	5.28	7.20	7.20	*8.80	8.00	8.00	8.80	4.75	*8.80	7.20	*9.60	*6.40	*8.80	7.20	7.20	8.00	*8.80	9.60	8.00	
Sioux City	1.00	1.00	.50	.85	.75	1.00	1.00	1.00	1.00	.50	.90	.75 .90	1.00	.60	1.00	.90	.90	.85	1.00	1.00	1.00	.60
St. Louis	1.25	1.25	1.00	1.25	1.31¼	1.50	1.35- 1.47	1.47	1.47	.78¾	1.25	1.25	1.50	1.06¼	1.43¾	1.17½	1.25	1.25	1 43¾	1.25	1.25	.76½
St. Paul	1.00	1.00		.80	.80	1.00	.80	1.00	1.00	.50	.90	.80	1.00	.70	1.00	.80	.80	.85	1.00	1.00	1.00	
Washington, D.C.	*1.50	1.75	.50 .75	*1.37½	1.25	*1.65	*1.37½	*1.65	*1.65	.75	*1.62½	*1.37	*1.75	*.75	*1.50	*1.37½	*1.37½	*1.50	*1.50	*1.25	*1.50	.75
Wichita	.60	.75 1.25	.25 .40	.40 .75	40 1.00	.50 .87½	.30 .75	.40 1.00	.40 1.00	.20 .40	.50 1.25	.50 .87½	.60 1.25	.25 .50	1.00	50 1.00	.50 1.00	.50 1.00	.75 1.12½	.75 1.25	.50 1.00	.25 .40
Youngstown††	*1.00	1.25	.60	.75-1.00	1.12½	1.00	1.12½	1.25	1.25	.40	1.00	1.00	1.25	.75	1.00	●‡1.00	1.00	1.00	1.00	1.25	1.25	.81¼

NOTE.—Where two figures are shown they are the minimum and maximum. All figures are for hour rates except as indicated. ††8-hour day. †Rate per hour. *On 5-day week basis. c Correction. Asterisk after city indicates all trades on five-day week basis.

ABOVE DATA ARE WAGE SCALES AND DO NOT NECESSARILY INDICATE ACTUAL WAGE RATES BEING PAID IN THE RESPECTIVE TRADES.

This is the first of a series of pages devoted to the modern treatment of certain interesting details in construction.

CORNER WINDOWS



A corner window in a bedroom. The sash, of steel or aluminum, operates separately, to give maximum ventilation. Below, the modern note is carried out in black structural glass.

Glass well deserves the added emphasis now placed upon it when it makes possible such a cheery, attractive dining alcove.

Here, the corner window extends floorward only to the level of a desk-top, making an especially pleasant and practical spot for writing or reading.

● The *improved* product now manufactured by Libbey • Owens • Ford is particularly suited to the new and more rigid requirements which the modern architectural trend demands of glass. Its superior quality and the acceptance it enjoys endorse our assertion that a closed specification for L•O•F Quality Glass will insure your client's complete satisfaction.

LIBBEY • OWENS • FORD GLASS COMPANY, TOLEDO, OHIO, *manufacturers of Highest Quality Flat Drawn Window Glass, Polished Plate Glass and Safety Glass; also distributors of Figured and Wire Glass manufactured by the Blue Ridge Glass Corp. of Kingsport, Tenn.*

(The details illustrated are from photographs taken in the Home Planning Section at the World's Fair.)

LIBBEY · OWENS · FORD
QUALITY GLASS

MANUFACTURERS' ANNOUNCEMENTS

Architects are invited to use the coupon on this page as a convenient means of obtaining manufacturers' publications describing in detail the products and materials mentioned.

A1
FORMICA

A brochure prepared by Formica Insulation Company of Cincinnati features the application of Formica to store fronts. This material, available in over 30 colors, is offered in black on an asbestos center board and in black and all other colors on moisture-proof press board which can be cut readily with carpenters' tools on the job. Developments in the Formica laboratory make it possible, according to the manufacturer's statement, to provide light colors which even in sunlight will retain original appearance for long periods. Color photographs showing four store front designs employing Formica are inclosed with the descriptive brochure offered for your inspection.

A2
PEDESTAL-TYPE KETTLE

For use in hospitals, schools and similar institutions as well as restaurants The Aluminum Cooking Utensil Company announces an improved pedestal-type Steam Jacketed Kettle. Steam and return lines are inclosed in the pedestal, access to the fittings provided by means of a door in the pedestal back. Manufacturer states that this new "Wear-Ever" design not only makes a better appearance but adds to kitchen sanitation and cleanliness.

A3
TONCAN IRON PIPE

"The Technical Story of Toncan Iron Pipe," a booklet issued by Republic Steel Corporation, gives complete information about the manufacture, applications and performance of the pipe. Toncan iron, one of the most popular of pipe materials, with which is alloyed copper and molybdenum, is said to be especially noteworthy for resistance to rust and corrosion. Toncan is described as the only iron pipe available in electric weld.

A4
THE NEW GENERAL ELECTRIC INSTITUTE

The new General Electric Institute at Nela Park, Cleveland, Ohio, embodies the facilities and functions of the former General Electric Kitchen Institute and General Electric Lighting Institute, besides housing a multitude of new features and services. Serving as a demonstration and testing laboratory for new advances in lighting and home management through the use of electrical servants, the new Institute also functions as a clearing house for information and advice. Pamphlets and bulletins are offered describing the architectural features and the variety of appliances employed in the equipment and furnishing of the Institute. This printed material, available on request, dwells at length upon the kitchen section with its model kitchens, its training school and research staff. The lighting also is a subject receiving special attention. Modernity and efficiency of the lighting of the kitchens, living room, front entrance, store interior and other model interiors are fully described and ilustrated.

A5
ROCKWALL ACOUSTICAL PLASTER

The Atlantic Gypsum Products Company announces Rockwall Acoustical Plaster. This product combines in a smooth-working, easily applied, durable acoustical plaster the necessary elements of pleasing appearance and high absorption. It requires no stippling or other manipulation of the surface for its acoustical results, but is simply finished with either a cork or trowel. Its natural color is gray-white, but it can also be furnished in several tints. The United States Bureau of Standards tests Rockwall Acoustical Plaster at 47 per cent sound absorption at a frequency of 512 cycles for a one-half inch application over a regular gypsum base coat. According to the manufacturer's belief this is the highest coefficient ever obtained on an acoustical plaster by a field test on a job installation.

To Obtain Further Information

about any products mentioned, indicate the number or name of product and send to THE ARCHITECTURAL RECORD, 119 West 40th Street, New York, N. Y.

.....

.....

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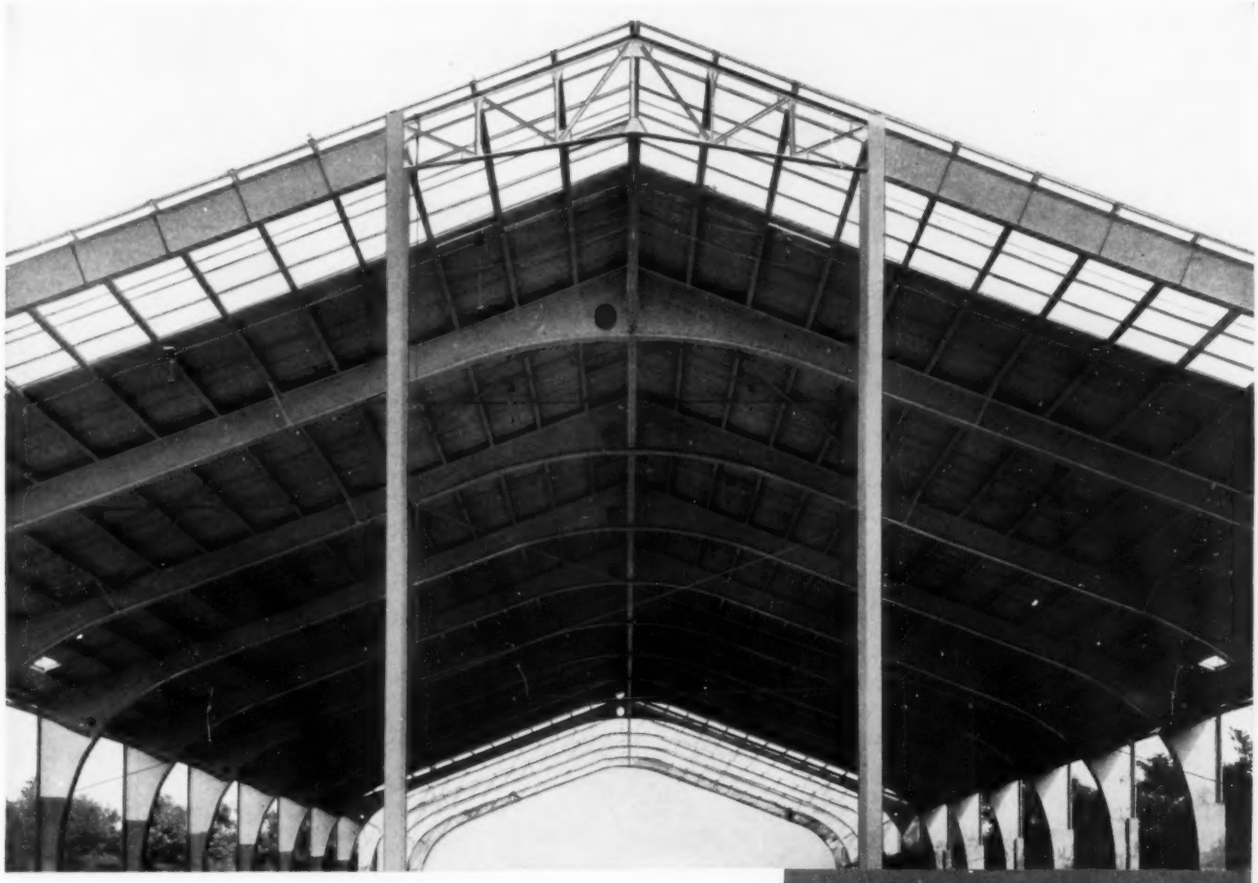
FORWARD



Like marble under the hand of the sculptor, structural steel ever can be relied upon to respond to the ingenuity of the engineer. Interesting are recent developments in the application of C B SECTIONS as simple and economical substitutes for conventional steel construction. Novel roof members in the University of Chicago Field House illustrated here, typify the adaptability of C B SECTIONS to improved construction methods. Further information on request.

CB SECTIONS

Producers of C B SECTIONS for the Central West

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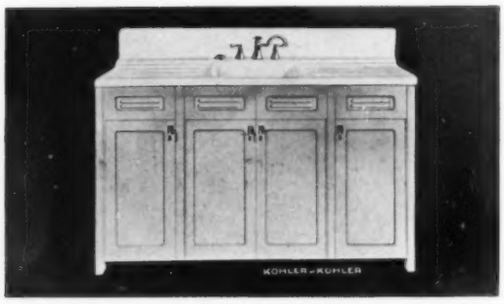


A6
KOHLER CABINET SINK

An enameled cabinet ledge sink, compact and convenient, is offered by Kohler of Kohler. Built-in, it fits into small, efficiently designed kitchens and yet is adapted to installation in larger rooms. Has toe recess at the bottom of the cabinet, making it possible to work close to the sink without stooping uncomfortably. An important refinement is the 3-inch integral ledge extending across back of sink and serving as a convenient shelf for soaps, brushes, etc. Space for pots, pans, kettles and other cooking utensils is provided on shelves in the side cabinets under the sink, while the central section accommodates a swing arm container for garbage or for utensils, a waste basket, brushes, cleaning compounds, etc. Air enters the cabinet through holes at the bottom and leaves through louvers at the top, assuring dry, sanitary storage. Available in many colors.

A7
PORCELAIN ENAMELED IRON

American Rolling Mill Company has published an interesting treatise on the "Relation of Porcelain Enameled Iron to Modern Architecture." It defines the properties of porcelain enamel and describes its manufacture and variety of applications. Many interesting facts about the material's durability, its resistance to severe thermal shock and to physical impact, its acid-resisting power and other advantages are treated in text and illustration. Manufacturer is prepared to supply copies on request.

A8
ACOUSTICAL MATERIALS ASSOCIATION

A bulletin containing technical data on acoustical materials for the benefit of architects, engineers and others interested in architectural acoustics will be issued between January 15 and February 1 by the Acoustical Materials Association, an organization formed last July by nine leading makers of these materials. The purpose of the bulletin, and also one of the aims of the association, is to furnish standardized technical data—particularly sound absorption coefficients—thus eliminating confusing variations in absorption data on different products. The establishment of such standards, members of the association believe, will prove beneficial to architects and others dealing with and using these materials.

A9
CHIMNEY POTS

The decorative and practical values of terra cotta chimney pots are dealt with in a booklet released by Atlantic Terra Cotta Co. of New York. Manufactured in thirty-one designs in a complete range of standard flue sizes and in a wide range of colors, Atlantic chimney pots are termed appropriate for all types of single residences and for the garden type of apartment house. The charm of chimney pots that are appropriately selected as to proportion and color, is depicted in the many illustrations appearance in the Atlantic booklet, ready for distribution to interested architects.

A10
AIR CONDITIONING

Air conditioning for stores, shops, restaurants and offices is the subject of an address before the American Society of Refrigerating Engineers meeting by W. C. Goodwin, Air Conditioning Engineer of Westinghouse Electric & Manufacturing Co. Mainly the paper deals with the unit air conditioner as differentiated from the central plant system. The conditions under which the unit device is recommended, the details of equipment and operation of the unit conditioner are fully explained. Copies of this address may be obtained on request.

TRADE ANNOUNCEMENTS

ROOF VENTILATOR INSTITUTE

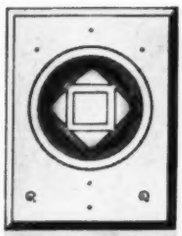
With the object of facilitating the industry's cooperation with the Government, the manufacturers of roof ventilators have formed a national organization, presided over by W. F. Hirschman. The new Roof Ventilator Institute has the further purpose of advancing the technical and business aims of the industry, coordinating the efforts of manufacturers, agents, engineers, contractors and other participants in the industry. Address of the Institute is 631 South Delaware Street, Indianapolis, Indiana.

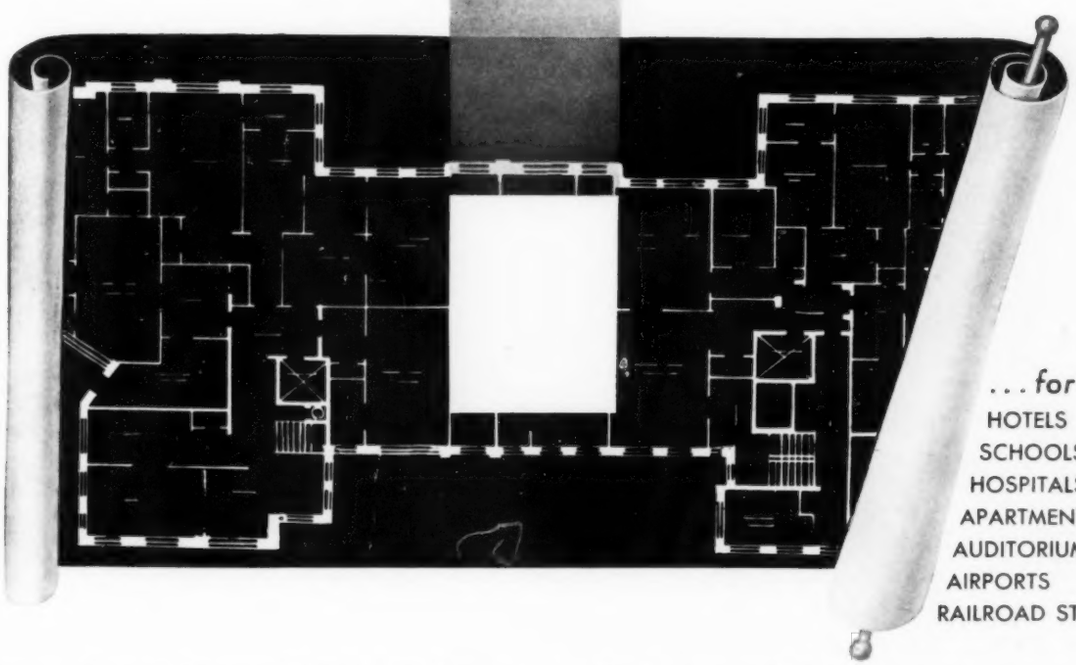
REPUBLIC STEEL CORPORATION

Karl Kautz, ceramic engineer, has joined the staff of Republic Steel Corporation and will specialize in research and field service on enameling sheets, according to announcement by Earl C. Smith, Chief Metallurgist of Republic. Mr. Kautz's former connections include American Range & Foundry Co., Northwestern Terra Cotta Co., Abingdon Sanitary Mfg. Co.

UNIVERSAL ATLAS CEMENT COMPANY

Appointment of C. S. McArdle as sales manager of the Kansas City, Mo., office of the Universal Atlas Cement Company, subsidiary of the United States Steel Corporation, and Fred T. Wiggins as sales manager of the company's Birmingham, Ala., office was announced January 2 by F. L. Stone, vice-president and general sales manager of the Universal Atlas Company.

Fit this  system for *building-wide* hearing into your 1934 plans . . .



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A Western Electric Program Distribution System makes for increased usefulness and convenience in large buildings of many types. Microphones pick up speech or music—a Reproducer Set plays phonograph records —a Radio Receiver brings in broadcasts. Amplified as needed, these programs are delivered throughout the building via loud speakers.

In hotels and hospitals, this System supplies music in many rooms, speeds up paging. In schools, the Reproducer Set aids in foreign language and music appreciation courses. In large meeting rooms everywhere, this equipment helps *all* to hear clearly.

For highest quality radio reception in apartment houses, there is the Radio Frequency Distribution System. Using only *one* antenna, this System provides antenna and lead-in facilities for as many as 3000 radios.

Whether you are designing new buildings or modernizing old ones, sound transmission experts will gladly assist you in planning for building-wide hearing.

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Installations of Western Electric Program Distribution Systems were made recently in the Rindge Technical High School, Cambridge, Mass., and the Brooklyn Technical High School, Brooklyn, N. Y.

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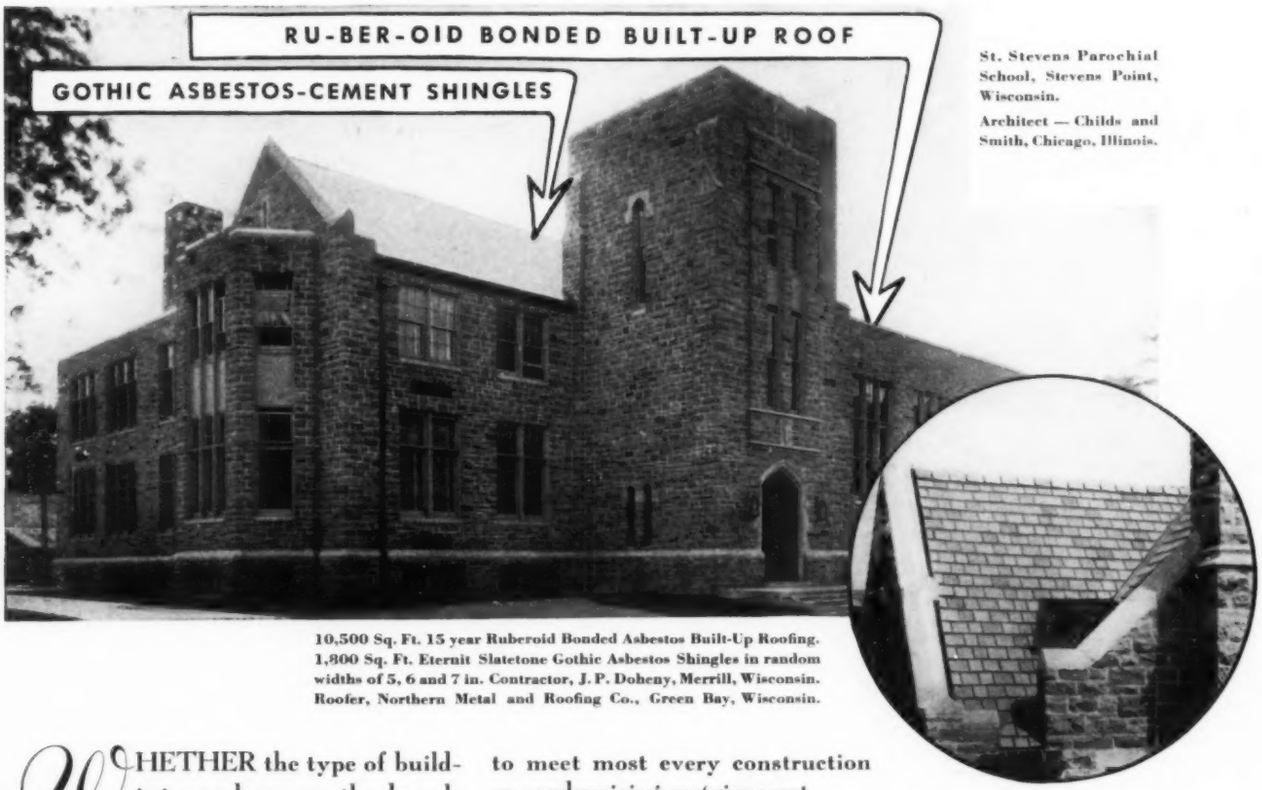

St. Stevens Parochial School, Stevens Point, Wisconsin.

Architect — Childs and Smith, Chicago, Illinois.

10,500 Sq. Ft. 15 year Ruberoid Bonded Asbestos Built-Up Roofing. 1,800 Sq. Ft. Eternit Slatetone Gothic Asbestos Shingles in random widths of 5, 6 and 7 in. Contractor, J. P. Doheny, Merrill, Wisconsin. Roofer, Northern Metal and Roofing Co., Green Bay, Wisconsin.

WHETHER the type of building you have on the boards is new construction or a modernizing job, if it requires a roof you can centralize your roofing responsibility on The Ruberoid Co.

Today in the Ruberoid line there are Built-up Roofs in all three popular types—Asbestos Saturated Felt and Asphalt, Tarred Saturated Rag Felt and Coal Tar Pitch, and Asphalt Saturated Rag Felt and Asphalt. Likewise, there is a wide variety of Asphalt and Asbestos Shingles in specifications, weights, finishes, etc., to meet most every construction or modernizing requirement.

For over 40 years The Ruberoid Co. has devoted its entire energy to providing quality roofings and building products. How well this company has succeeded may be judged by Ruberoid's constant widening of its line of products and the reception of these products by leading architects and engineers the world over.

When you have a roofing to select, think of RU-BER-OID and refer to Sweet's. When you have a specific problem, phone any Ruberoid office.

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NRA WE DO OUR PART

SEE 1934 SWEET'S ARCHITECTURAL CATALOGUES

N. B. C. AIR CONDITIONING

By A. WARREN CANNEY

(Continued from page 88, editorial section)

erage of 8 minutes. Air movement in each room and studio is everywhere gently positive and uniform. A relative humidity of 45 per cent is maintained at all times in fully occupied rooms, and a few per cent less in unoccupied rooms.

Ductwork on the tenth floor, which is devoted exclusively to the air conditioning air handling equipment excepting the upper part of the 3-story studio, averages four ducts deep. Minimum headroom is 6′ 6″ and the average about 8′.

This plant is full-automatic in its operation with the exception of starting motors. Control instruments provide control with a constant accuracy which could not be accomplished manually. The control room instruments were furnished by the Taylor Instrument Corporation. These instruments provide control by obtaining a compressed air delivery pressure to pneumatic diaphragm valves which is proportional to the change from the control point setting.

Every engineer's control room, client's observation and public observation room have special individual control. These controls also preclude the very objectionable possibility of over-cooling.

There is no direct contact between any duct, pipe or equipment of this system with any part of the structure. Most of the tenth floor air handling is directly over ninth floor studios. Keeping sounds out of the floor required foundations requiring very high attenuations. They employ spring clips scientifically spaced, sized and loaded.

This air conditioning system is the most vast and complex system yet installed. There are nearly one million pounds of sheet-iron in the ducts alone. All the supply ducts are combined sound and heat-flow proofed. Consequently when the air leaves the tenth floor apparatus its psychrometric conditions are unchanged throughout the supply duct to the room delivery outlet.

This system was contracted for and installed by the Carrier Engineering Corporation based on plans and specifications prepared by the author as air conditioning engineer on the staff of Clyde R. Place, Consulting Engineers for Rockefeller Center.

Sound Isolation

The sound isolation of the system follows two basic principles. First, the provision of the same effective attenuation of the soundproof construction which would exist if the thin sheet-metal ducts did not exist, puncturing, as they do, this extremely efficient construction. In many studios the area of these holes exceeds 100 square feet. Balance this problem against the fact that a pinhole would be very apt to ruin the soundproofing. Second, all sounds generated by the operation of the equipment, which include sounds created by virtue of

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the flow of air in the system, must be silenced to within a specific intensity level. This level is so low that, contrary to one's being able to hear any sound in any of the studios (there is no activity at the time of listening, of course), there is a peculiar sensation due entirely to the fact that people are not accustomed to so much "absence of sound." The perfection with which extraneous sounds are kept out of the electrical circuit from studio to antenna is almost unbelievable. The inherent ground noise at the antenna can be no lower than that existing at the microphone. This is why there has been such concentrated effort in silencing the air conditioning system to a point comparable to the level which would be obtained were it not installed at all.

Pressure Distribution

In lounges where considerable cigarette smoking has been anticipated, as also in the toilets, the movement of air is governed entirely by pressure distribution. There can be no feed-back of smoke or odor. Such air is not returned to the system.

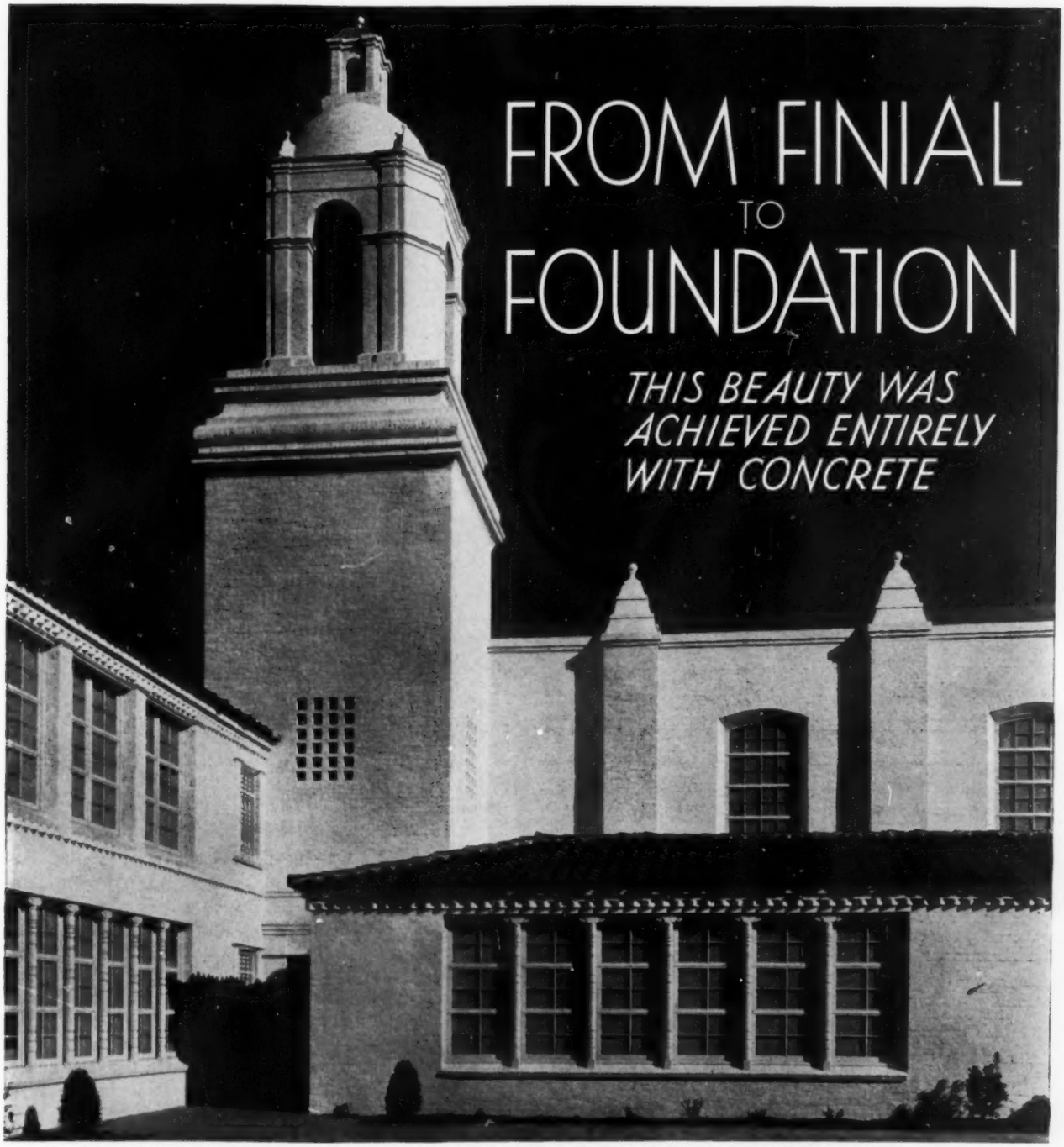
Where headroom conditions are under ten feet in spaces other than the studios proper, a method of distribution is used which requires air behind the outlet at a higher pressure than has been customary in building work. Less air is required, which permits the decided advantage of smaller ductwork, but the decrease of fan horsepower is partly offset by the additional compression. The outlet uses slots having a nozzle section through which air is introduced at very high velocity. Using the principle of viscosity, a secondary quantity of air is induced and automatically mixed with the air from the slots, reducing its velocity within limits established by the "length of blow" desired, and producing the primarily desired result of a mixture-temperature approaching room temperature. This mixture of delivery "stays up" for a greater horizontal distance of discharge, and thereby helps to overcome drafts.

Control Instruments

The control instruments shown on a portion of the 60-foot panel in Figure 12 indicate the stringent performance requirements of the system. The author segregated the recording mechanism from the control mechanism as a part of the basic design. These instruments not only automatically control, but provide a full daily continuous record of the results in each studio and other important spaces and points controlled. This record and hence any tendency to change is visually exposed to the operating engineer. The important feature is that should the control fail, manual regulation may be effected for that studio at the equipment serving that studio until repairs are made. Conversely, if the recording fails, the control will continue to function automatically.

Filtration

A feature of this system lies in the method of filtration. In order to provide wholesome air and to protect fabrics, all the delivered air is doubly filtered. The filter units operate on a principle of



The Mariano Guadalupe Junior High School, Vallejo, California. *Architect:* Frederick H. Reimers. *Structural Engineer:* Norman Green. *Contractors:* San Francisco Construction Company.

Here the architect desired a masonry unit which in size and shape would conform to the Spanish tradition. Concrete tile was the logical choice. • Not only does it create an interesting and appropriate wall texture, but it is permanent, and low in cost. Concrete tile has ample structural strength for bearing walls of this height—another material factor in keeping costs down. • All ornament on this school is of pre-cast concrete. First floors are concrete. Portland cement mortar was used throughout. • Concrete tile is one of many forms in which concrete masonry units are obtainable. Houses, commercial buildings or public structures, may be built of concrete masonry, successfully and economically. We will be glad to supply further information upon request.

PORTLAND CEMENT ASSOCIATION

Room 281—33 West Grand Ave., Chicago, Ill.

EVANS
"Vanishing
Door"
WARDROBE

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Class J

equipped with either "Floor" type (as illustrated) or "Jamb" type hinges. This is Class D wardrobe if made with flush doors.

CLASSROOM WARDROBES
High in Quality—Low in Cost

This type occupies a recess flush with the wall. Plaster back and ends. No partitions, but with mullions between pairs of doors. Wire mesh ceiling. Blackboards if required.

The "Vanishing Door" hinges on which the doors are hung are made with double pivoted arms and swing the doors back into the wardrobe entirely out of the way. Simple—trouble-proof—and last as long as the building.

Wardrobes are furnished complete in the knockdown, with all woodwork cut to size, and only need to be nailed in place. The hinges are easier to put on than common butt hinges. The entire cost of installation is small.

We make many other types of school wardrobes, fully illustrated and described in 1934 Sweet's, Volume C, pages 656-663.

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subdividing the air handled into small turbulent whirlpools, causing impingement on an interlaced network of fine viscously-coated strands 4 inches deep.

The method of handling the air in this system emulates the application of the very principle which controls the flow of air. In short, air volumes are everywhere controlled by the automatic variation of resistance and consequently the pressure. The theory that air movement, like every other problem of dynamics in nature, will follow the path of least resistance is used. This is the first system of size known to the author wherein the volume of air at every point in the apparatus is thus automatically controlled. Automatic pressure regulators which are sensitive to pressure changes less than .00036 pound per square inch, are employed to help do this.

Other Features

Considerable advance has been made in air handling. For example, free use is made of "square elbows" in the ductwork, due to structural or space conditions. This means the turning of the air at right angles with a 90 degree square-edged ell. After considerable research a formula has been developed for the design of these so that they are both quieter and less resistant than a wide radius elbow.

One feature which should be of particular interest to architects is the prevention of condensation on the interior surfaces of windows when it is cold outside. This is effected without changing the atmospheric results in any other spaces served by the entire system.

Operation

The design was made on the basis of a cost analysis which included the balancing of the consumption of operating utilities and labor. Fourteen telephones aid the operating staff which works over three eight-hour shifts. Mr. Robert Close, the chief operating engineer in charge of the plant, employs his own staff electrician and a cost analysis engineer who is an air conditioning specialist. Intelligent operation is secured through a routine system of logs and reports whereby the maximum operating economy is secured but without sacrificing results in the slightest.

The National Broadcasting Company cooperated with the architects to provide a special public observation space of the air conditioning on the tenth floor. Here the dust-proof, glass-inclosed control room may be seen by visiting guests of the guide tour now inaugurated by N.B.C. A soundproofing demonstration, the method of filtration, a demonstration exhibiting the remarkable degree of attenuation obtainable in treated and untreated ducts by actually talking through them, and the air handling equipment may be examined. It is the author's recommendation to every reader to visit this exhibit on the guide tour. While pride cannot help but enter this recommendation, it is only fair to say that the instructive value of so doing necessarily exceeds a written description.

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REPUBLIC'S PERFECTED STAINLESS AND HEAT-RESISTING STEELS

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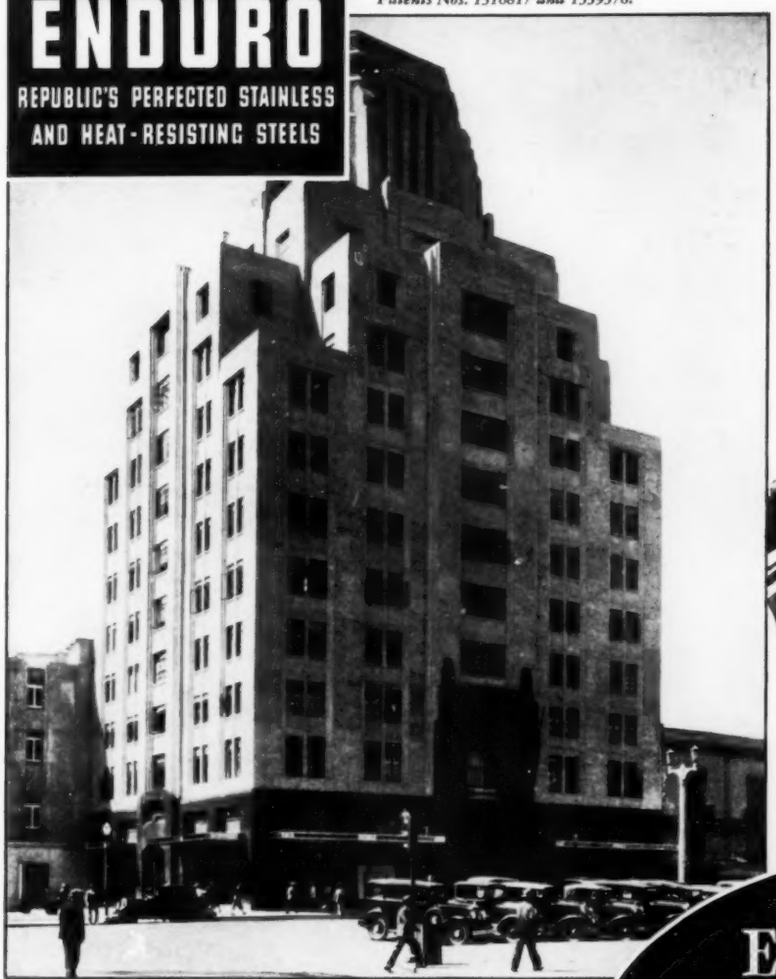

ENDURO INVADES *Mexico*

The first architectural installation of ENDURO of real importance in Mexico is the new La Nacional Building in Mexico City. The building is owned by La Nacional Cia. de Seguros sobre la Vida, S. A. and was constructed at a cost of 1,300,000 pesos.

ENDURO, Republic's Perfected Stainless Steel, was specified for the four marquees and lobby decoration by the architects, Monasterio, Calderion y Avilla, after a thorough inspection of the many outstanding ENDURO installations in New York City. The metal was fabricated by Adam Rubalcava, an ENDURO enthusiast.

This building south of the Rio Grande is a tribute to the beauty of this almost noble metal —the metal that neither time nor the elements will deface—the metal that is practically everlasting.

Architects planning today for the buildings of the future will do well to investigate ENDURO. See Sweet's Catalogs or write for literature.

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